DOCUMENT RESUME

ED 236 311 CE 037 005

AUTHOR McCully, James S., Jr., Comp.
TITLE Lesson Plans for Teaching Basic Vocational Agriculture. Section III. Introduction to Soil Management and Classification.
INSTITUTION Mississippi Research and Curriculum Unit for Vocational and Technical Education, State College.; Mississippi State Dept. of Education, Jackson. Div. of Vocational and Technical Education.
PUB DATE Apr 83
NOTE 107p.; For related documents, see ED 199 552 and CE 037 361.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Agribusiness; *Agricultural Education; *Agronomy; Behavioral Objectives; Classification; Curriculum Guides; *Land Use; Learning Activities; Lesson Plans; *Locational Skills (Social Studies); Measurement; Secondary Education; *Soil Science; Transparencies; *Vocational Education
IDENTIFIERS *Area (Geometry)

ABSTRACT

This publication, one of five sections, was developed for use in first and second year basic agriculture courses in secondary schools in Mississippi. The five lessons focus on the measurement and description of property and the classification of land. The purposes of the lessons are to (1) introduce the units and methods used to measure distance and calculate area; (2) provide information concerning the location of land, using the rectangular survey method for a legal description; (3) develop the student's ability to identify the components and textural class of a soil; (4) provide knowledge of general soil properties and develop the student's ability to estimate these properties in a given soil; and (5) develop the student's ability to classify a soil into standard classes and to designate the highest safe use of that soil. Each lesson uses the same format and consists of an introduction, terminal and specific objectives, instructional procedures (teaching tasks and steps to accomplish each task), learning activities (the instructional materials needed to teach the lesson in a question-and-answer format and transparency masters), supplemental learning activities, a list of supplemental learning aids (reference materials), and a lesson summary. Job sheets, student assignment sheets, and answer sheets are provided. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED236311

Lesson Plans for Teaching Basic Vocational Agriculture

Section III

Introduction to Soil Management and Classification

Compiled by
James S. McCully, Jr.
Research and Curriculum Specialist

Published by the

Division of Vocational-Technical Education
Mississippi State Department of Education
Jackson, Mississippi

and

Research and Curriculum Unit for Vocational-Technical Education
College of Education
Mississippi State University
Mississippi State, Mississippi

April 1983

CE 037005

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Direct inquiries to:

Research and Curriculum Unit
for
Vocational-Technical Education
College of Education
Drawer DX
Mississippi State, Mississippi 39762
Phone: (601) 325-2510

Mississippi State University does not discriminate on the basis of race, color, religion, national origin, sex, age, or handicap.

PREFACE

This publication is the third in a series of five publications designed to be used in teaching basic vocational agricultural courses in secondary schools in Mississippi.

It is the result of two years of effort on the part of the author, Mississippi vocational agriculture teachers, state staff members, and teacher educators to produce materials which will improve the quality and quantity of instruction in all programs.

Vocational agriculture has been undergoing a transition during the past ten years. Our programs are being called upon to serve a wider population of students with varying occupational goals. We are being called upon to provide training which is **directly related** to the preparation of an individual for employment. This instruction must be related to the occupation or occupations for which the students are being trained.

These materials are designed to assist teachers in providing such training. They are, to as great an extent as possible, skill-oriented. Most of the lessons are devoted to teaching a student **how** to do something — evaluate livestock, select seed, make soil test, use hand tools, etc. In most instances, however, the lesson also attempts to provide knowledge of basic principles associated with this skill.

ACKNOWLEDGEMENTS

This publication is the result of a cooperative effort between teachers, teacher educators, and state staff members to update programs of basic vocational agriculture throughout Mississippi. The author wishes to express his thanks and acknowledgement to the following persons for their efforts and advice in developing these materials:

Dr. James F. Shill, Director of the Research and Curriculum Unit

Mr. C.M. Brewer, State Supervisor of Vocational Agriculture

Dr. Ron Brown, Teacher Educator, Mississippi State University

Dr. Jasper Lee, Teacher Educator, Mississippi State University

Dr. Bennie L. Byler, Teacher Educator, Mississippi State University

Dr. W.F. Jackson, Teacher Educator, Alcorn State University

Mr. P.L. Fluker, Teacher Educator, Alcorn State University

Mr. E.N. Elliott, Teacher Educator, Alcorn State University

The teachers of vocational agriculture who served as review committee members deserve special recognition and thanks for their help. These teachers helped to establish the content outline of this publication and also made valuable suggestions concerning improvement of the finished materials.

Mr. Reese T. Ishee, West Jones High School

Mr. Charlie Thames, Edinburg High School

Mr. Jimmy Newman, Hinds Junior College

Mr. Bobby Kelley, Franklin County Vocational School

Mr. Drew Lenard, Vaiden High School

Mr. Arlon Cox, Smithville High School

Mr. Dwight Brown, Faulkner High School

Mr. Keith Culpepper, Runnelstown High School

TABLE OF CONTENTS

	page
SCOPE	1
USING THIS PUBLICATION	3
LESSON 16. Measurement of Land Area	5
LESSON 17. Legal Description of Land	39
LESSON 18. Components of Soil	75
LESSON 19. Properties of Soil	99
LESSON 20. Classification of Soils and Land	121

SCOPE

This publication represents Section III of the curriculum materials developed for use in basic vocational agriculture courses. The lessons in this section focus on the measurement and description of property and the classification of land. The overall purpose of each lesson can be described as follows:

Lesson 16. Measurement of Land. This lesson is designed to introduce the student to the units and methods used to measure distance and calculate area.

Lesson 17. Legal Description of Land. This lesson provides information concerning the location of land using the rectangular survey method.

Lesson 18. Components of Soil. This lesson is designed to develop the student's ability to identify the components and textural class of a soil.

Lesson 19. Properties of Soil. This lesson provides knowledge of general soil properties and develops the student's ability to estimate these properties in a given soil.

Lesson 20. Classification of Soils and Land. This lesson is designed to develop student ability to classify a soil into standard classes and to designate highest safe use of that soil.

USING THIS PUBLICATION

These materials are designed to be used in teaching courses in basic vocational agriculture in secondary schools in Mississippi. In using these materials, each teacher is advised to remember the following pointers:

1. The materials are not a total curriculum for teaching basic vocational agriculture. No statewide effort at standardization of curriculum will ever produce a curriculum which will meet the needs of every program in the state. Every teacher is advised to use the parts of these materials which are related to the local program and to add any units or lessons which are not provided.
2. Each lesson is designed to be adapted to local needs. Every teacher is encouraged to review each lesson prior to teaching it and to add any objectives or teaching material which is needed in the local situation. Spaces have been left in the text of the materials to add notes and objectives.
3. The materials may be used in first-or second-year basic vocational agriculture courses. When first discussed, these materials were planned for use in first year courses only. The volume of the material, however, is more than can be taught in one year. Teachers are advised to use materials in both first- and second-year courses.
4. The materials are performance-oriented. The lessons are aimed at developing some observable performance within the student. In many cases, this performance goes beyond passing a written test to include some type of "hands-on" activity. Teachers should make prior preparation to include these activities before teaching the lesson.

Each lesson in this publication was developed using the same format and consists of an introduction, terminal and specific objectives, instructional procedures, learning activities, supplementary learning activities, and supplementary learning aids. Each of these sections is described below.

1. **Introduction.** The introduction usually consists of two paragraphs. The first paragraph provides some background information relating to the topic to be discussed. The second paragraph states the goal of the lesson in general terms.
2. **Objectives.** Each lesson contains a terminal objective and a set of specific objectives which should be followed in order to accomplish this terminal objective.
3. **Instructional Procedures.** This section of each lesson is divided into a group of teaching tasks and steps to accomplish each task. These procedures are suggested procedures only. Teachers are encouraged to "review the entire lesson and determine if additional material is needed."
4. **Learning Activities.** This section contains the instructional materials needed to teach the lesson. For the most part, the question-and-answer type of format which has been used in previous Mississippi reference units is used along with student assignments and job sheets to emphasize certain points. Full-page transparency masters are included in the text of this section.

5. **Supplementary Learning Activities.** Suggestions are made in this section concerning additional activities which can be used to supplement the information provided by the lesson text.

6. **Supplementary Learning Aids.** A list of supplementary reference materials including publications and available films is included in this section.

LESSON 16

Measurement of Land Area

I. **Introduction:**

Land is a resource which is common to almost all agricultural enterprises including production agriculture, forestry, horticulture, and even agribusiness. Whether the agriculturist is a cotton farmer with thousands of acres or an agribusinessperson with a lot in an urban setting, almost all persons involved in agriculture/agribusiness have a tie with the ownership or use of land.

For accurate location and measurement of boundaries and corners, the services of a licensed surveyor are necessary. In some instances, however, the landowner may only want an estimate of acreage in a given tract. Estimates can be useful for double-checking the rate of application of fertilizer, seeds, or pesticides. They can also be used to estimate yield from a given field. This lesson is designed to introduce the student to the units and methods used to measure distance and calculate area.

II. **Objectives:**

A. **Terminal objective.** Upon completion of the lesson, the student should be able to estimate the area of a given tract or lot of land.

B. **Specific objectives.** Upon completion of this lesson, the student should be able to do the following:

1. Define terms related to land measurement.
2. Describe methods used to measure land area.
3. Measure a given tract of land using a chain or steel tape.
4. Measure a given tract of land using the pacing method.
5. Calculate the area of a given tract of land.

III. **Instructional Procedures:**

Teaching Tasks	Steps to Accomplish Tasks
A. Prepare for class.	1. Review entire lesson and determine if additional material is needed. 2. Prepare transparencies and student assignments. 3. Prepare student assignment sheets.
B. Introduce the lesson.	1. Discuss the importance of land measurement as related to different areas of agriculture/agribusiness. 2. Discuss importance of land measurement as related to practices such as fertilizer application, pesticide application, seeding rates, etc. 3. Define new terms.
C. Describe the methods used to measure land area.	1. Discuss the use of U.S. System and SI System measurement. 2. Discuss precise methods for measuring distance. 3. Discuss pacing method for measuring distance.

Teaching Tasks	Steps to Accomplish Tasks
D. Describe procedure for measuring a tract of land using a tape or chain.	1. Discuss steps found in Section C of Learning Activities. 2. Demonstrate procedure using a plot of land near the school. 3. Allow students to practice measuring distance.
E. Describe procedure for measuring a tract of land using the pacing method.	1. Discuss material in Section D of Learning Activities. 2. Describe procedures for determining the average length of a person's pace as described in Job Sheet 16a. 3. Have students determine the average length of their pace. 4. Have students measure distances using pacing method.

Teaching Tasks	Steps to Accomplish Tasks
F. Describe procedures for determining the area of a tract of land.	1. Discuss general procedure for determining the area of a given tract of land (Job Sheet 16b). 2. Discuss procedure for determining the area of a rectangular tract of land (TM 16c). 3. Discuss procedure for determining the area of a triangular tract of land (TM 16d). 4. Discuss procedure for determining the area of a trapezoidal tract of land (TM 16e). 5 Discuss procedures for determining the area of an irregular shaped tract of land (TM 16f). 6. Have student estimate by pacing the number of square feet in several tracts of land on the school campus. 7. Have students complete the Assignment Sheet.
G. Summarize the lesson.	1. Discuss key points to remember found in Lesson Summary.

13

IV. **Learning Activities:**

A. **New terms and definitions.**

1. *U.S. System.* The system of weights and measurements which is most commonly used in the United States and some parts of the United Kingdom. Basic units of the U.S. System include inches, ounces, and fluid ounces.
2. *International Standard (SI) or Metric System.* The system of weights and measures which is most commonly used outside of the United States. Basic units of the SI or metric system include meters, grams, and liters.
3. *Square feet.* The basic unit of land measurement in the U.S. system. An area of land which is 1 foot (12 inches) long on each of 4 sides or equal to 144 square inches.
4. *Square meter.* The basic unit of land measurement in the SI system. An area of land which is 1 meter long on each of 4 sides or equal to 10,000 square centimeters. (A meter is approximately equivalent to 39.37 inches, 3.28 feet, or 1.094 yards.)
5. *Square yard.* An area of land which is 1 yard (3 ft.) long on each of 4 sides or equal to 9 square feet.
6. *Acre.* An area of land which is 208.71 feet long on each of 4 sides or equal to 43,560 square feet.
7. *Hectare.* An area of land which is 100 meters long on each of 4 sides or equal to 10,000 square meters. (1 hectare=2.47 acres.)
8. *Rod.* A distance of $16^1/_2$ feet.
9. *Chain.* A distance of 4 rods or 66 feet. 1 square chain equals .1 acre. 10 square chains equal 1 acre.

B. **What methods are used to measure land area?**

Measurement of land area is basically a process of determining the length of the boundaries of the land and calculating the area from these figures. In the United States, the length of the boundaries is most commonly measured in feet, rods, or chains, and the area of the land is determined in square feet or acres. In most of the rest of the world, length is measured in meters, and area is measured in hectares. Since the legal description of almost all land in the United States is based upon the U.S. System of measurements, this lesson will focus on determining square footage or acreage of a given tract of land. Conversion of land descriptions and measurements to the SI system will require that the entire United States be completely resurveyed and that all deeds and titles to land be completely converted to the new system. It is not anticipated that these measures will be taken until some time in the far future.

A licensed surveyor uses precise measurements to determine the area of a land tract. Normally the surveyor will use the legal description of the land tract to determine the precise location of the boundary corners. A compass or transit level will be used to establish a straight line which can be measured from one boundary corner to another. The distance from one corner to the other may be determined by using any of the following devices:

1. *Surveyor's chain.* Originally all land was surveyed using a Gunter's chain which is 66 feet long and is composed of 100 links, each 7.92 inches. Ten square chains equal one acre.
2. *Surveyor's tape.* A tape which is usually 2 chains (132 feet) in length and is graduated into links and rods.
3. *Slope tape.* A surveyor's tape which has a graduated scale attached to allow a correction for the amount of slope in the land.
4. *Engineer's tape.* A tape which is usually 200 or 300 feet in length and graduated into feet and inches.
5. *Measuring wheel.* A bicycle-type wheel of known diameter which can be rolled along the boundary. Each turn of the wheel is counted and the distance from point to point is determined by multiplying the number of turns times the circumference of the wheel. Some wheels may have counters which provide a direct reading of the distance.
6. *Electrical measuring devices.* Several types of electrical devices have been devised which can accurately measure distances from one point to another.

Once the distances between corners is determined, the area of the tract can be calculated.

Often a farmer or agribusinessperson needs an estimate of the acreage or square footage of a given tract of land. On small tracts or lots, it may be possible to measure the boundaries using a tape or a piece of string with knots tied at every 25, 50, or 100 feet. Large or small tracts of land can be measured approximately by pacing the boundaries. Pacing involves walking the boundaries and counting the number of paces from one corner to another. A pace is not one step, but two. In counting paces, count only the number of times that one foot hits the ground. Based upon the average length of one's pace, the distance walked can then be roughly determined.

To determine the average length of one's pace, a person should first accurately measure a given distance — 100 feet, for example. The person should then walk this distance several times taking normal steps and counting the number of paces taken each time. The average number of paces taken each time can then be determined. By dividing the total distance by the average number of paces taken to walk this distance, the person can calculate the average length of his/her step. (Refer to Job Sheet 16a.)

In measuring distance by pacing, the person should be careful to walk in a normal manner at all times.

C. **What is the procedure for measuring a given tract of land using a chain or tape?**

In measuring a tract of land using the chain or tape, the following procedure should be followed:

1. *Locate and clearly mark the corners of the plot to be measured.* If the tract is so large that the corners cannot be seen from each other, the boundaries should also be marked so that a straight line from one corner to another can be followed.

2. *In taping a distance from one corner to another, the taping crew starts at one corner and proceeds in a straight line to the other corner.* The lead person pulls the tape or chain until the rear person reaches the corner marker. The rear person positions the end of the tape exactly over the corner marker. The rear person then uses a compass or visual judgment to make sure the lead person is correctly aligned on the boundary. After making sure that the end of the tape is directly over the marker and the tape is on the boundary line, the rear person says "Chain." The lead person then stretches his/her end of the tape until it is taut and level with the rear end of the tape. The lead person then precisely marks the lead end of the tape with a marker and stays "Stuck." This signals the rear person to move the rear of the tape to the new marker. The lead person then pulls the lead end of the tape forward, and the process is repeated.

3. *Upon reaching the corner, the distance traveled is calculated.* The procedure is then repeated until the distance from corner to corner is determined. Some plots or tracts of land may have more than four corners.

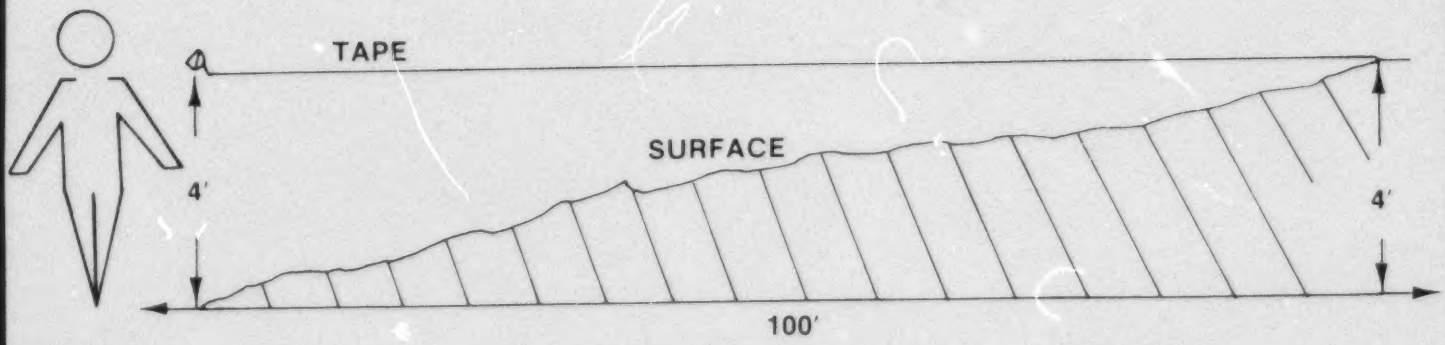
4. *In chaining on slopes, it is important to keep the chain or tape level to the earth's surface and not level to the surface of the land being surveyed.* Using a 100-foot tape on a 4 percent slope, the downhill end of the tape would have to be held approximately 4 feet above the ground. TM 16a illustrates this concept. Surveyors may use special chains or tapes which have a built-in scale which allows for the slope. In estimating area or distance, the slope will usually not be significant unless extremely steep slopes are encountered.

5. *If major obstacles such as ponds, large buildings, or lagoons are encountered in measuring the distance from one corner to another, the chaining team should move at a right angle to the obstacle until the obstacle is cleared.* The team then measures the distance from that point to the point where the obstacle ends. They then move at a right angle until the boundary is reached and resume measurements there. TM 16b illustrates this procedure.

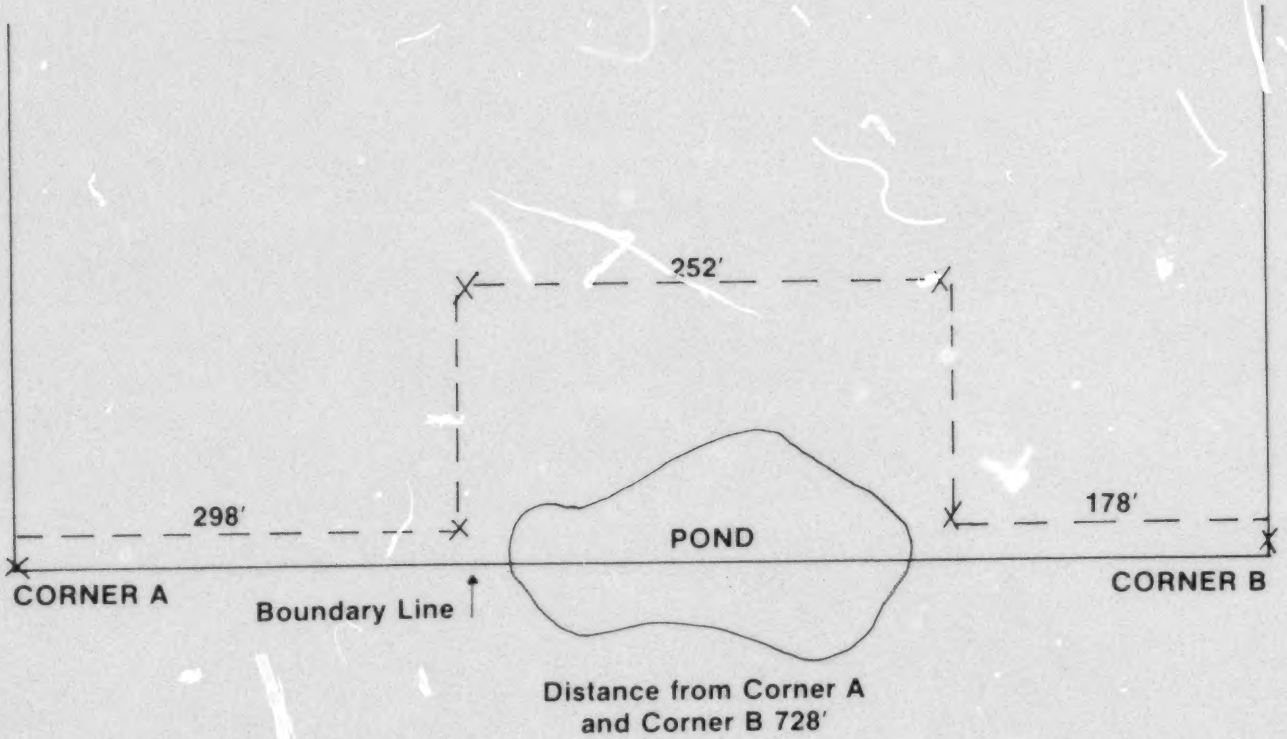
D. **What procedures should be used in estimating the measurement of a tract of land by using the pacing method?**

In general the same procedure is used in pacing a boundary as is used when using a chain or tape. While the measurements obtained are usually not as accurate as those obtained by chaining, the procedure requires only one person and takes less time. With practice a person can obtain a good estimate of distance from one point to another. When pacing any distance, be sure to allow for extra steps that may be required in crossing ditches or gullies. (Refer to Job Sheet 16b.)

Chaining a Four Percent Slope



Measuring around Major Obstacles



E. **How is the area of a given tract of land calculated?**

After the distance between all corners is measured, the area of the land can be calculated. For square or rectangular tracts of land, the formula for calculating the area is simply length times width. TM 16c shows the calculation for a rectangular tract which is 10 chains (660 feet) wide and 20 chains (1320 feet) long. Area of the tract is calculated by measuring length by width. In this case, 10 chains times 20 chains would equal 200 square chains, or 660 feet times 1320 feet would equal 871,200 square feet. (Note that you must convert both measurements to the same unit of measurement. You cannot multiply the number of chains of width by the number of feet of length.) Usually large tracts of land are measured in acres. To convert square chains to acres, divide the total number of square chains (200) by the number of square chains in one acre (10). To convert square feet to acres, divide the total number of square feet (871,200) by the number of square feet in one acre (43,560). In both cases the answer is the same, 20 acres.

Unfortunately, not all tracts of land are in the shape of a rectangle or square. In these cases, the estimator must use good judgment in determining boundaries and marking corners prior to measuring. TM 16d shows a triangular tract of cleared land surrounded by woods. The entire tract is 5 chains wide by 10 chains long and contains 50 square chains or 5 acres. To determine the acreage in the cleared area, however, the estimator must first establish three corners. The distance from Corner A to Corner C must be measured as well as the distance from Corner B to the boundary between Corners A and C. To determine the area of the cleared space, the estimator must multiply the length of the longest side of the triangle (7 chains or 462 feet) times the height of the triangle ($3\frac{1}{4}$ chains or 214.5 feet) and divide the result by 2. The calculations would yield an answer of 11.4 square chains or 49,434 square feet. Dividing by the conversion factors, the area of the cleared space could be determined to be approximately 1.14 acres.

In TM 16e another commonly encountered situation is shown. The entire tract of land represents an area of 40 acres. A drainage ditch is placed diagonally across the tract and the owner wishes to know approximately how many acres are on each side of the ditch. The estimator must determine the distance from the center of the drainage ditch to each corner of the boundaries it crosses. These distances are 25 chains and 35 chains for Plot 1, and 15 chains and 5 chains for Plot 2. Width of both plots is 10 chains. To determine the area of Plot 1, the estimator must find the average length of the two sides ($25 + 35 \div 2 = 30$), and multiply this by the width (10). Plot 1 would then contain 300 square chains or 30 acres. Plot 2 would contain an area of 10 acres. ($15 + 5 \div 2 = 10$; $10 \times 10 = 100$ sq. chains = 10 acres). The amount of land used by the drainage ditch is not considered to be significant in this situation.

Measurement of irregularly shaped tracts of land is a more complicated procedure. The estimator must divide the tract into plots having the regular shapes of squares, rectangles, triangles, or trapezoids. The area of each plot is then calculated, and then the areas of all plots are summed. An example of this procedure is shown in TM 16f. This tract represents a total area of 3200 square chains or 320 acres. The owner has cleared much of the tract, but left small wooded areas. The owner desires to estimate the acreage which has been cleared. In this case the most simple method to use is to measure the wooded areas, and subtract the total wooded acreage from the total acreage of the tract. Each of the wooded areas (Plots 1-4) is measured, and their area calculated as follows:

1. *Area of Plot 1*

   Area = 619 ft. × 825 ft. = 510,675 square feet

   510,675 sq. ft. ÷ 43,560 sq. ft. per acre = 11.7 acres

2. *Area of Plot 2*

   Area = 1075 ft. × 950 ft. ÷ 2 = 510,625 sq. ft.

   510,625 sq. ft. ÷ 43,560 sq. ft. per acre = 11.7 acres

3. *Area of Plot 3*

   Area = 660 ft. × 990 ft. = 653,400 sq. ft.

   653,400 sq. ft. ÷ 43,560 sq. ft. per acre = 15 acres

4. *Area of Plot 4*

   a. Area = 910 ft. × 1275 ft. = 1,160,250 sq. ft.

      1,160,250 sq. ft. ÷ 43,560 sq. ft. per acre = 26.6 acres

   b. Area of triangle A

      Area = 575 ft. × 990 ft. ÷ 2 = 284,625 sq. ft.

      284,625 sq. ft. ÷ 43,560 sq. ft. = 5.6 acres

   c. Area of wooded area of Plot 4 = 26.6 acres - 6.5 acres = 20.1 acres

5. *Total area of wooded land (including pond)*

   Area = 11.7 acres + 11.7 acres + 15 acres + 20.1 acres = 58.5 acres

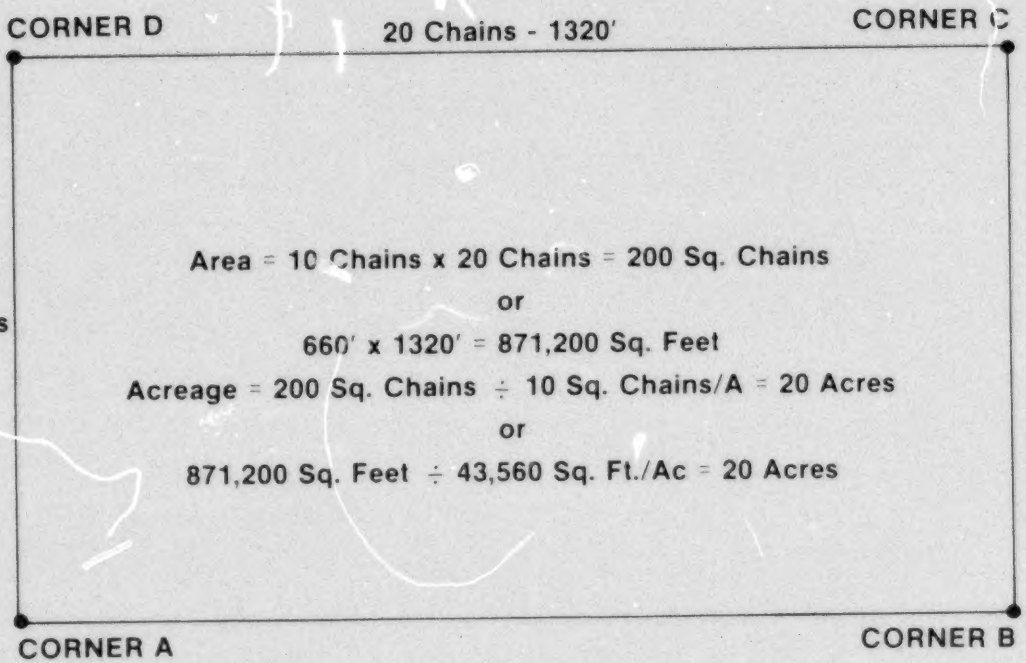
6. *Area of cleared land*

   Area = Total area - wooded area

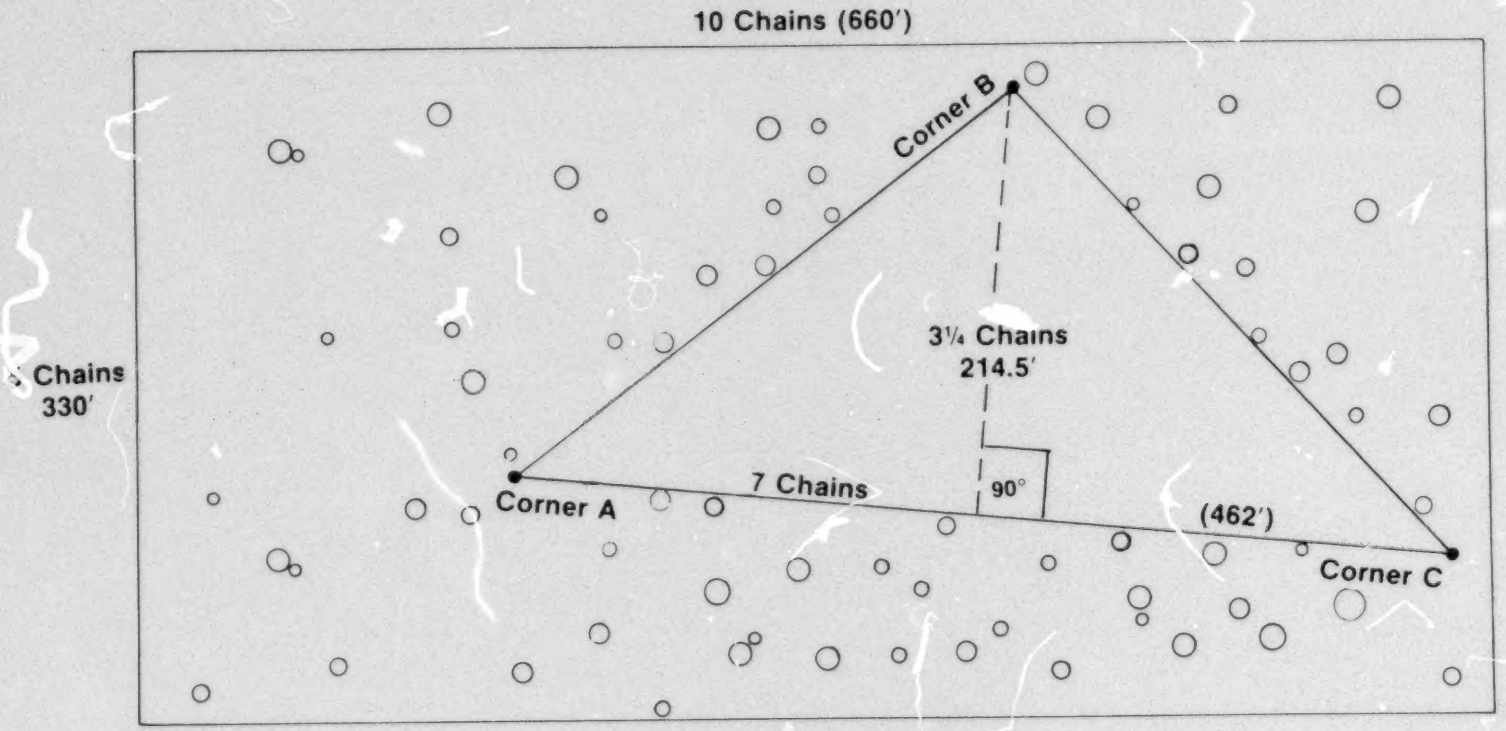
   = 320 - 58.5 = 261.5 acres

In determining the estimated acreage of the cleared land in this tract, the estimator calculated acreages to the nearest tenth of an acre. It should be emphasized that these figures are estimates of the acreage involved and are not accurate measurements.

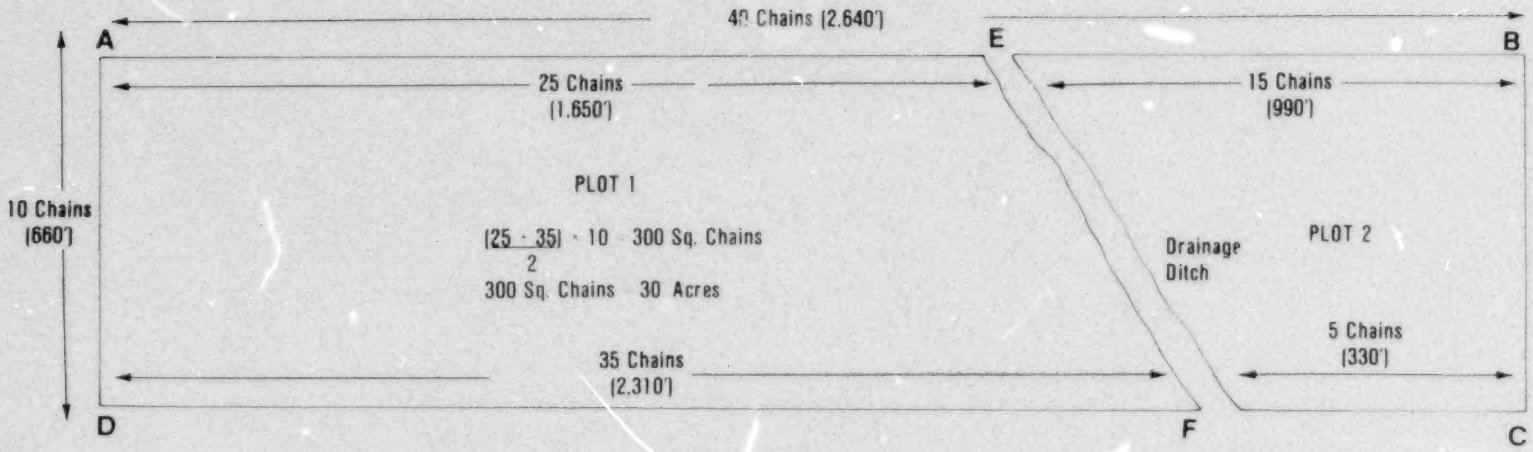
Calculation of the Area Of a Rectangular Tract of Land


CORNER D
20 Chains - 1320'
CORNER C
10 Chains
660'
Area = 10 Chains x 20 Chains = 200 Sq. Chains
or
660' x 1320' = 871,200 Sq. Feet
Acreage = 200 Sq. Chains ÷ 10 Sq. Chains/A = 20 Acres
or
871,200 Sq. Feet ÷ 43,560 Sq. Ft./Ac = 20 Acres
CORNER A
CORNER B

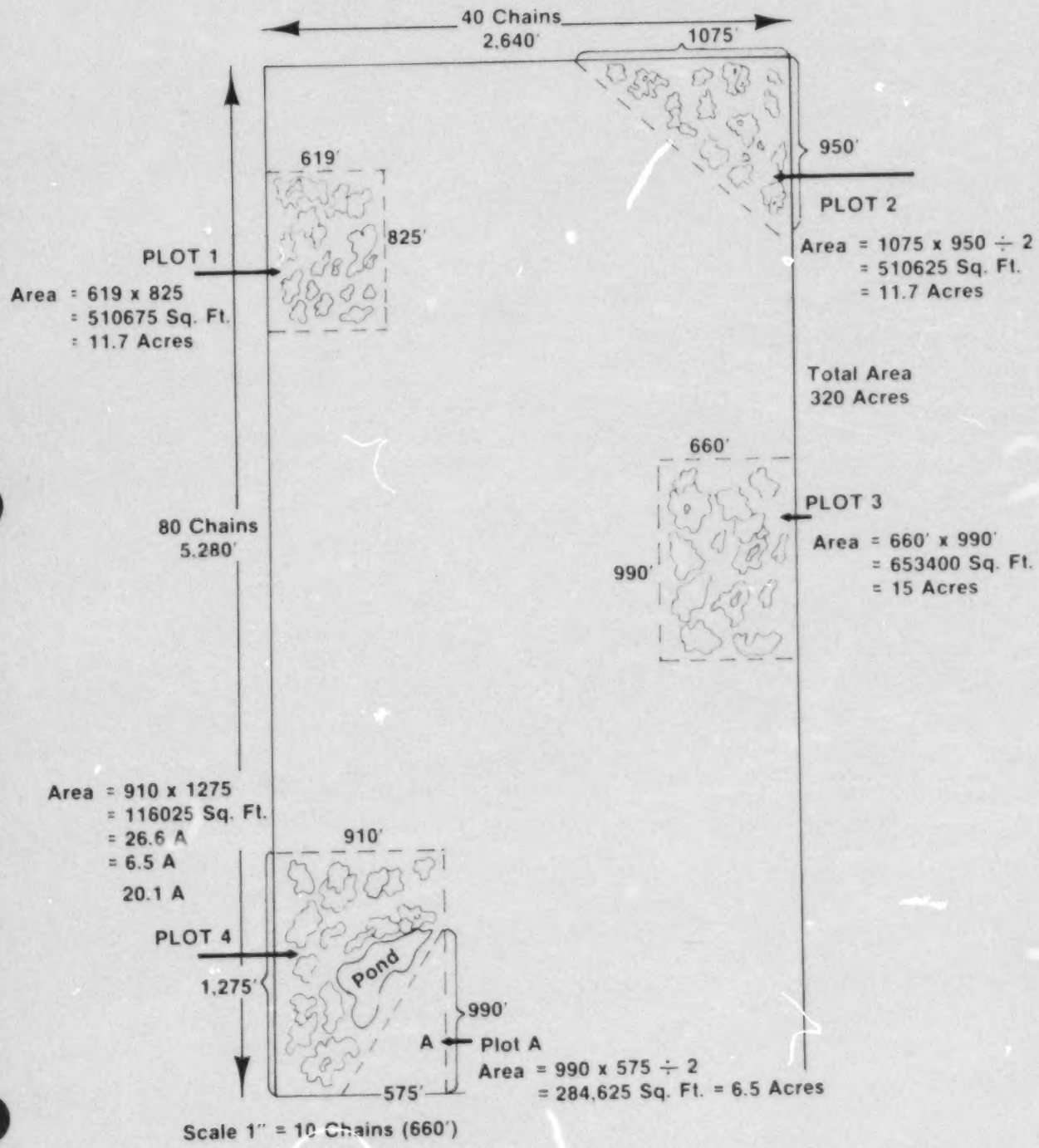
Calculation of the Area Of a Triangular Tract of Land



Calculation of the Area Of a Trapezoidal Tract of Land



Calculation of the Area
Of an Irregularly Shaped Tract of Land



JOB SHEET 16a

Determining the Average Length of a Person's Pace

In many instances, the pacing method can be used as a fairly accurate method for estimating the distance from one point to another. Prior to using this method, a person must first determine the average length of his/her normal pace. Once this length has been determined, approximate distances can be easily determined.

Remember, a pace is equal to two steps. If you make your first step with your right foot, then count the number of times your left foot falls. If you begin on the left foot, then count the number of times your right foot hits the ground.

Procedure:

1. Using a measuring tape or chain, measure a set distance along a straight line on level ground. Example: 300 feet (100 yards).
2. At a normal walking pace, walk this distance 10 times and record the number of paces that you make each time. Example: 63 paces, 64 paces, 64 paces, 63 paces, 65 paces, 64 paces, 63 paces, 65 paces, 64 paces, 64 paces.
3. Add the total number of paces required to walk the line and divide by 10.

   (Example: 639 paces ÷ 10 = 63.9)
4. Divide the average number of paces required to walk the line into the length of the line. This figure will represent the average length of your pace.

   (Example: 300 feet ÷ 63.9 paces = 4.70 feet per pace.)
5. In making future measurements, you need to walk a straight line from one point to another and count the number of paces you make. Multiply the number of paces made by the average length of 1 pace to determine the distance you have walked.

   (Example: 227 paces × 4.70 feet per pace = 1067 feet)

JOB SHEET 16b

Measuring the Area of a Tract of Land by Pacing

In many instances the acreage or square footage of a tract of land can be approximately determined by the pacing method. The procedure outlined below should be followed on tracts of level or nearly level land.

Procedure:

1. Draw a sketch of the area to be paced.
2. Starting at one corner, walk in a normal manner and in a straight line toward the next corner. Count the number of paces taken.
3. If major obstacles are encountered, stop the count. Turn at a right angle and walk away from the boundary until the obstacle can be bypassed. Resume counting paces and walk parallel to the boundary until the obstacle is passed. Stop counting and walk back to the boundary. Resume the count and walk in a straight line to the next corner. Record the total number of steps taken on the sketch.
4. After reaching the corner, walk in a straight line toward the next corner.
5. If deep ditches or gullies are encountered, adjust the count to allow for distance walked in traveling up and down the ditch banks..
6. Walk all the boundary lines from corner to corner recording the number of paces required to walk each boundary.
7. Calculate the number of feet between each corner by multiplying the number of paces taken times the average length of one pace.
8. Calculate the area of the tract by using the appropriate formula:
   a. Area of a square or rectangle = *length of one side* times *width.*
   b. Area of a triangle = *length of base* times *length of height* divided by *2.*
   c. Area of a trapezoid = *length of short side* plus *length of longer side* divided by *two.* Multiply this figure by the width.
9. Calculate acreage by using conversion factors.
   a. Divide square footage by 43,560 to determine acreage in tract.
   b. Divide square chains by 10 to determine acreage.
   c. Divide square yards by 4840 to determine acreage.

V. **Supplementary Activities:**

A. Have local surveyor or forester demonstrate the methods used to precisely measure the area of a given tract of land.

B. Mark the corners of several plots on or near the campus. Have students pace the plots, calculate the area, and compare results.

C. Have students complete student assignment on the following pages.

ASSIGNMENT SHEET 16a

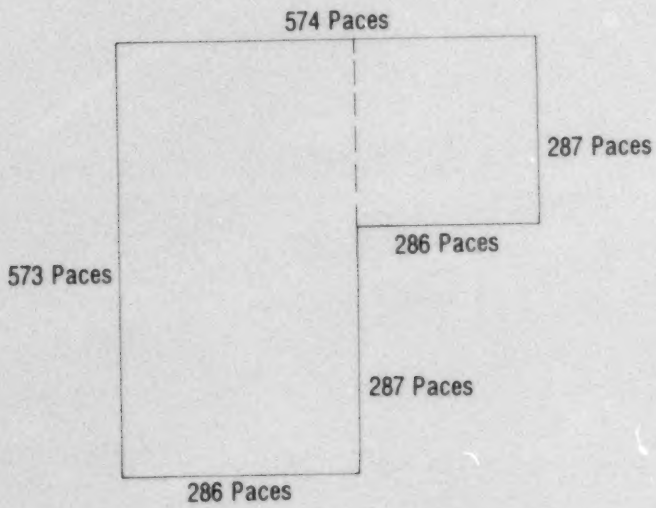
Calculate the area of the following tracts of land. Your calculations should be made in square feet. Determine the acreage in each tract to the nearest one-tenth acre.

1. A rectangular commercial lot in town is 150 feet wide and 120 feet deep.

2. A vegetable plot is triangular in shape (maximum length — 225 feet; maximum depth — 145 feet).

3. A farmer rents a tract of land which is 600 paces in length and 300 paces wide. If the average length of the farmer's pace is 4.4 feet, how many acres are in the tract?

4. A forester paces the boundaries of the tract of land sketched below and marks the length of the boundaries on the sketch. If the forester's average pace is 4.6 feet in length, how many acres are in the tract?



5. A farmer installs a new farm road across one field which has the following dimensions: length, 1320 feet and width, 660 feet. If the road crosses the field as shown in the sketch below, how many acres are in the tract on the left side of the road?

32

ANSWER SHEET

Assignment Sheet 16a

1. Area = 150 ft. × 120 ft. = 18,000 sq. ft.
   Acreage = 18,000 sq. ft. ÷ 43,560 sq. ft. per acre = .4 acres
2. Area = 225 ft. × 145 ft. ÷ 2 = 16,312.5 sq. ft.
   Acreage = 16,312.5 sq. ft. ÷ 43,560 ft. = .4 acres
3. Distance of length = 600 paces × 4.4 feet per pace = 2,640 feet
   Distance of width = 300 paces × 4.4 feet per acre = 1,320 feet
   Area = 2,640 ft. × 1,320 ft. = 3,484,800 sq. ft.
   Acreage = 3,484,800 sq. ft. ÷ 43,560 sq. ft. per acre = 80 acres
4. Distance of 574 paces = 574 paces × 4.6 ft. per pace = 2640 feet
   Distance of 573 paces = 573 paces × 4.6 ft. per pace = 2636 feet
   Distance of 286 paces = 286 paces × 4.6 ft. per pace = 1316 feet
   Distance of 287 paces = 287 paces × 4.6 ft. per pace = 1320 feet
   Distance of 287 paces = 287 paces × 4.6 ft. per pace = 1320 feet
   (To calculate the area of this tract one should divide the tract into two plots.)
   Area Plot 1 = 2,640 ft. × 1,316 feet = 3,474,240 sq. ft.
   Acreage Plot 1 = 3,474,240 sq. ft. ÷ 43,560 sq. ft. per acre = 79.8 acres
   Area Plot 2 = 1,316 ft. × 1,320 ft. = 1,737,120 sq. ft.
   Acreage Plot 2 = 1,737,120 sq. ft. ÷ 43,560 sq. ft. per acre = 39.9 acres
   Total acreage = 79.8 acres + 39.9 acres = 19.7 acres
5. Area = $\frac{1}{2}$ (725 ft. + 1,155 ft.) × 660 ft.
   = $\frac{1}{2}$ (1,880 ft.) × 660 ft.
   = 940 ft. × 660 ft. = 620,400 sq. ft
   Acreage = 620,000 sq. ft. ÷ 43,560 sq. ft. per acre = 14.2 acres

VI. **Supplementary Learning Aids:**

A. **Transparency Masters**

1. TM 16a Chaining a 4 Percent Slope
2. TM 16b Measuring around Major Obstacles
3. TM 16c Calculation of the Area of a Rectangular Tract of Land
4. TM 16d Calculation of the Area of a Triangular Tract of Land
5. TM 16e Calculation of a Trapezoidal Tract of Land
6. TM 16f Calculation of an Irregularly Shaped Tract of Land

B. **References**

Curtis, Ed. Forestry: **A Curriculum Guide.** Stillwater, OK: Oklahoma State Board of Vocational and Technical Education, 1974.

Legault, Adrian R., et. al. **Surveying: An Introduction to Engineering Measurements.** Englewood Cliffs, NJ: Prentice Hall, Inc., 1966.

VII. **Lesson Summary:**

Key points to remember:

A. While many other weights and measurements in the United States are being converted to the SI (metric) system, it is anticipated that the customary U.S. system of measurement will continue to be used for measuring agricultural land. This statement is based upon the fact that almost all deeds and titles to lands in the United States are based upon the U.S. system of measurements. To convert these deeds and titles will require a complete resurvey of the entire country.

B. Distance between two points is measured on a straight line from one point to the other. Steel tape, chains, measuring wheels, or electronic devices can be used to measure distance accurately. Pacing can be used to measure distances approximately.

C. For precise measurements of boundaries and corners, a licensed surveyor should be contacted. The accuracy of measurements between corners is affected by the experience of the measuring crew and the type of measuring instruments used.

D. For approximate measurements of area or distance, the pacing method can be used. While pacing is less accurate than chaining or taping, it requires only one person and is much less time consuming.

E. To determine the average length of one's pace, walk a line of known distance several times. Count the number of paces made each time. Divide the total number of paces taken by the number of trips made. Divide this figure into the length of the line to determine the average length of one pace.

F. To convert the number of paces taken in walking a line into feet, multiply this number times the average length of one pace. Round the answer off to the nearest whole foot.

LESSON 17

Legal Description of Land

I. **Introduction:**

An understanding of the method by which land is legally described and recorded is desirable for most agribusinesspersons. Ownership of land is based upon the legal description of the tract as recorded in the Chancery Clerk's office in the county seat of each county. Often the amount of acreage in a tract can be determined from the legal description of the land.

This lesson is designed to introduce the student to the methods used to describe the legal location of land.

II. **Objectives:**

A. **Terminal objective.** Upon completion of this lesson, the student should be able to interpret the legal description of a tract of land and locate the tract on a simple grid map.

B. **Specific objectives.** Upon completion of this lesson, the student should be able to accomplish the following:

1. Define terms and definitions associated with the legal description of land.
2. Describe the rectangular system of measurements used to describe the location of land.
3. Interpret legal descriptions of land and plot locations on a single grid map.
4. Describe the system used to describe the location of land in urban areas.

III. Instructional Procedures:

Teaching Tasks	Steps to Accomplish Tasks
A. Prepare for class.	1. Review entire unit and determine if additional material is needed. 2. Prepare transparencies. 3. Prepare student assignment sheets.
B. Introduce the lesson.	1. Discuss material found in Introduction. 2. Discuss terms and definitions.
C. Describe the rectangular system of measurements.	1. Discuss the 7 steps listed in Section B of Learning Activities. Use TM 17a-17f. 2. Obtain a map of the local area and point out the section and township lines. Point out sections containing less than 640 acres due to corrections made for curvature of the earth.

Teaching Tasks	Steps to Accomplish Tasks
D. Interpret legal descriptions of agricultural land.	1. Discuss examples shown in TM 17g and 17h. 2. Make Student Assignments 1 and 2.
E. Discuss methods by which lots in urban and suburban areas are described.	1. Discuss material in Section D of Learning Activities. 2. Provide examples of plots of a local city area and the legal description of local lots.
F. Summarize the lesson.	1. Discuss key points to remember in Lesson Summary.

IV. **Learning Activities:**

A. **New terms and definitions:**

1. *Legal description of land.* A method by which the exact location, corners, and boundaries of a tract of land can be recorded for future reference.
2. *Base line.* An imaginary line which runs in an east-west direction and serves as a reference point in describing the location of land.
3. *Prime meridian.* An imaginary line which runs in a north-south direction and also serves as a reference point in describing the location of land.
4. *Section.* A tract of land which is 1 mile square and contains 640 acres, more or less.
5. *Township.* A tract of land which is 6 miles square and contains 36 sections, more or less.
6. *Range.* A row or line of townships which extends in a north-south direction from the prime meridian.
7. *"More or less."* When used in a legal description of land, this term indicates that the actual area of the tract may be more or less than the specified acreage because of the earth's curvature.

B. **What system is used to describe the legal location of land in Mississippi?**

The system by which the location of land in Mississippi is located is based upon a rectangular system of measurements which was developed in 1784. With only minor modification, the system has been used in all states in the United States with the exception of the original thirteen colonies, Kentucky, Tennesse, and some parts of Texas. Basically, the system can be described as follows:

1. *An initial point is selected which is located in an area which is convenient to the larger area to be surveyed.*

2. *From the initial point, a prime meridian line is extended in a north-south direction, and a base line is extended in an east-west direction.* Prime meridians and base lines used in Mississippi are shown in TM 17a.

3. *Guide meridians are then established at a set distance parallel to the prime meridian on both the east and west sides of the prime meridian.*

4. *Standard parallels are then established at a set distance parallel to the base lines.* The tracts of land formed by the intersections of the guide meridians and standard parallels are approximately square in shape and are usually 24 or 30 miles long on each side except the northern side.

   TM 17b shows an initial point, base line, prime meridian, and the resulting standard parallels and guide meridians. Notice that the standard parallels are curved due to the curvature of the earth's surface and do not run in a true straight line.

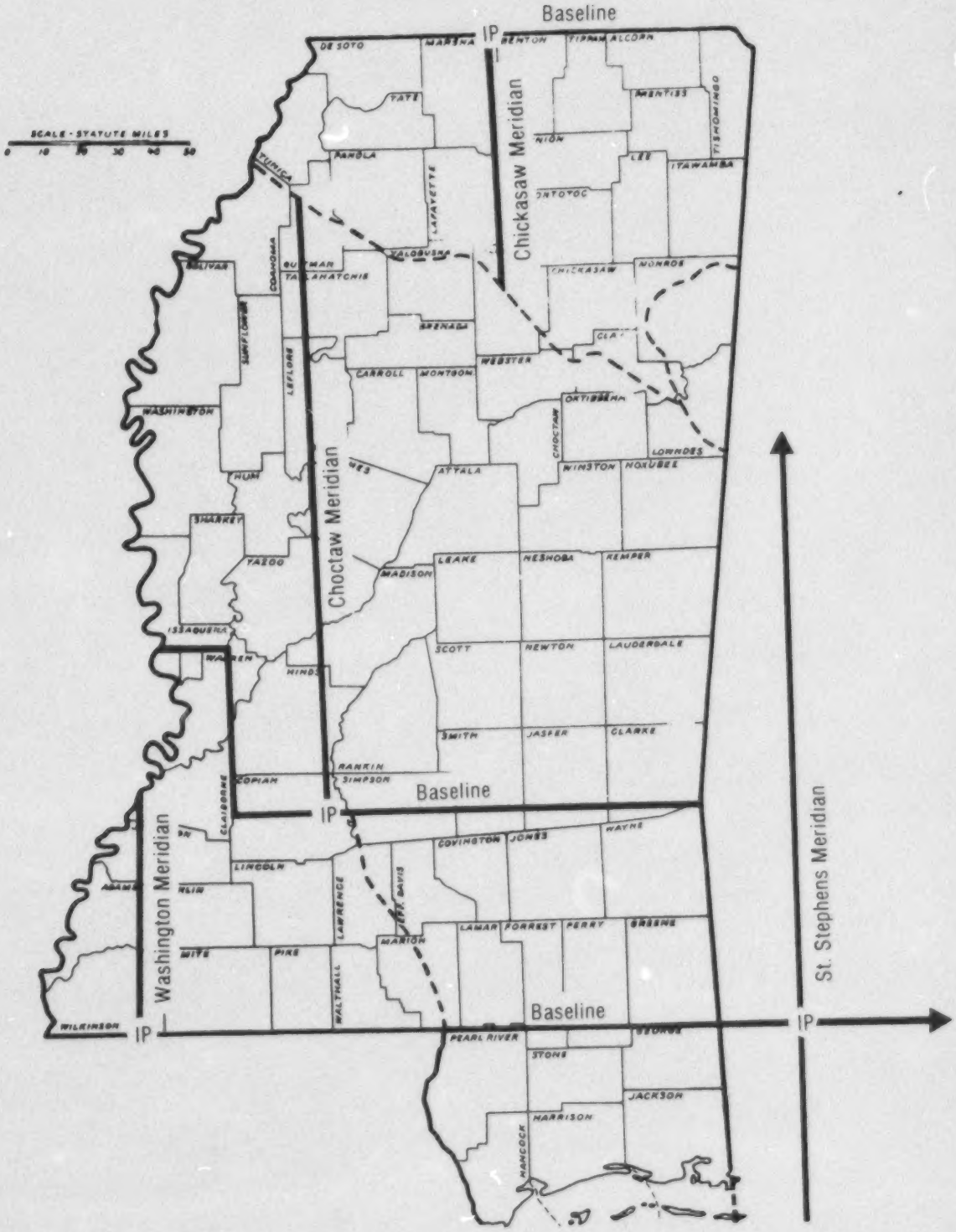
5. *After the standard parallels and guide meridians have been established, the townships are surveyed and marked.* A township is an area of land which is approximately 6 miles square and contains 36 sections. A range of townships is a line of townships which runs in a north-south direction. The first range of the townships on the east side of the prime meridian is referred to as Range 1 East and is abbreviated R1E. The next range east of the meridian is Range 2 East or R2E. The first line of townships north of the base line is referred to as Township 1 North and is abbreviated T1N. TM 17c shows how the townships and ranges are identified. Notice that the east-west lines are not straight but curve due to the curvature of the earth's surface.

6. *Each township is divided into 36 sections.* A section is an area of land which is approximately one mile square and contains 640 acres more or less. TM 17d shows a township which has been divided into 36 sections. Notice that the sections are numbered beginning in the upper right hand corner of the township and moving to the left. The sections are numbered consecutively in a right to left, and then left to right, manner from 1 to 36. Unlike the prime meridians, base lines, guide meridians, standard parallels, and township lines, the section lines are run in a straight line and do not curve with the curvature of the earth. As a result of this, Sections 1-6, 7, 18, 19, 30, and 31 will usually contain less than the required 640 acres. Any deficiencies which may exist in the survey are always placed in the north and west sections of the township. Generally speaking, every 16th Section in each township belongs to the public school system. Land in this 16th Section cannot be sold but is leased to others and the money from these leases is used to support the public schools.

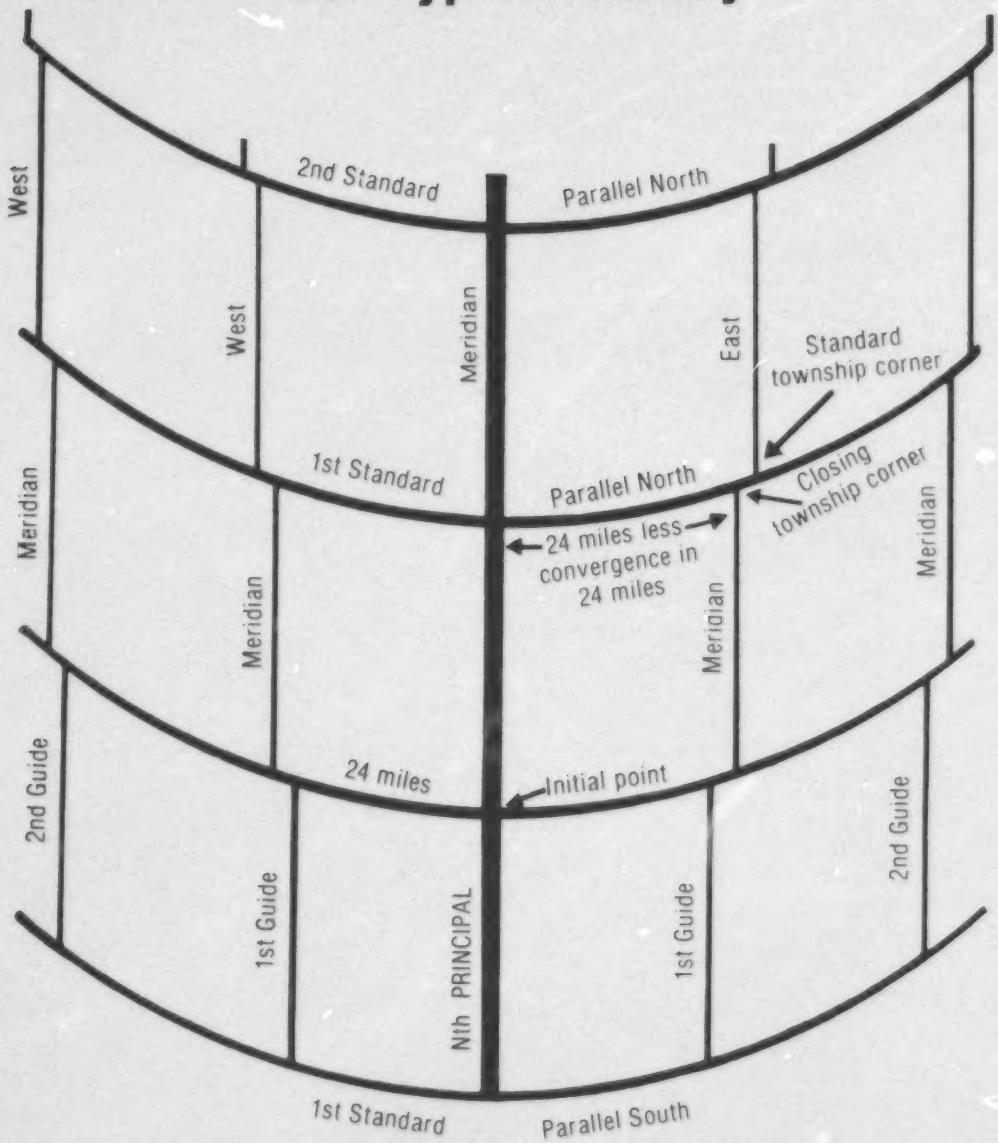
7. *Each section can be further subdivided into half sections, quarter sections, and smaller units.* Half sections contain 320 acres, more or less. Quarter sections contain 160 acres, more or less, and are identified by their location in the section. TM 17e shows the 4 quarter sections of a typical section. Each quarter section can be also divided into 4 quarters and the 4 quarters can then be divided into 4 quarters. TM 17f shows different ways in which a section can be divided. Chart 17a contains the written description, abbreviation and acreage of the plots shown in TM 17f.

40

Location of Initial Points, Prime Meridians, and Baselines in Mississippi



Initial Point, Base Lines, and Meridians For Typical Survey



Subdivision of Land into Townships and Ranges

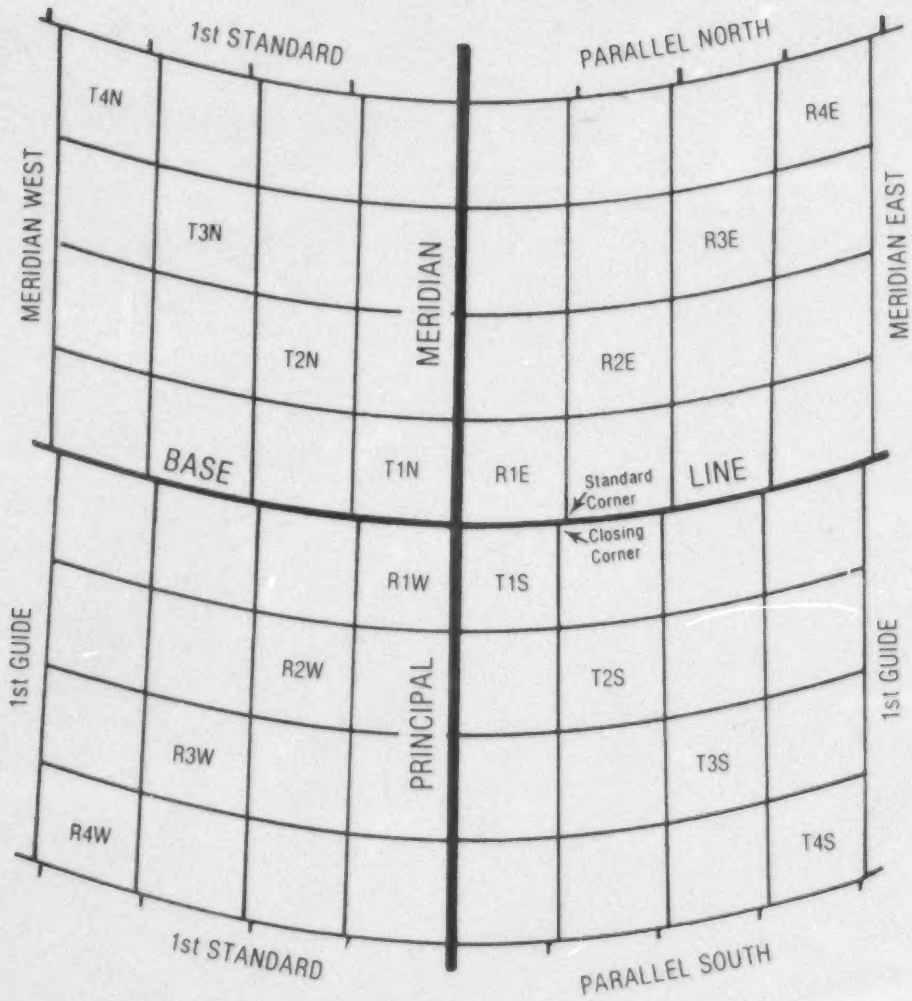


CHART 17a

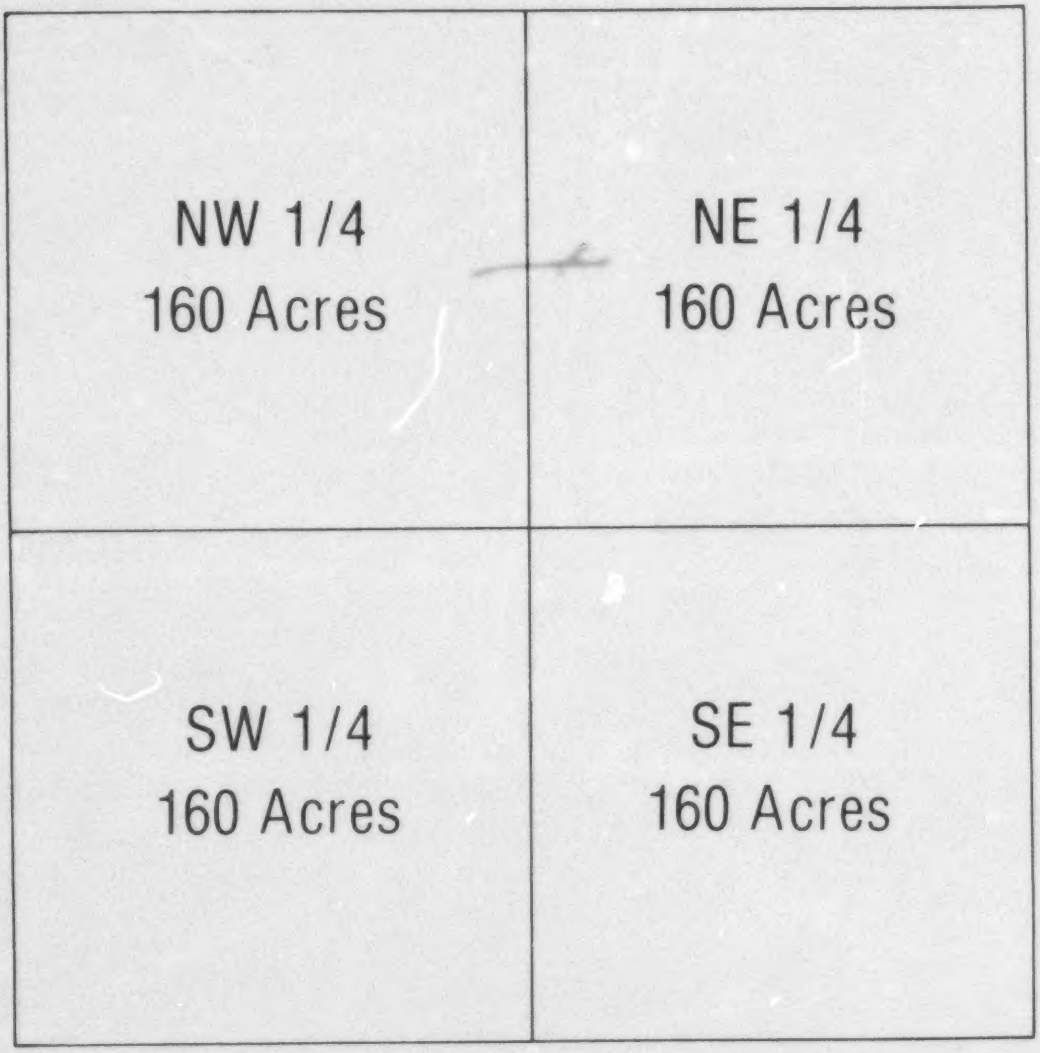
Descriptions and Abbreviations of Subdivisions of a Section (See TM 17f.)

Plot	Description	Acreage	Abbreviation
A	The east half of the section	320	$E^1/_2$
B	The northwest quarter of the section	160	$NW^1/_4$
C	The west half of the southwest quarter	80	$W^1/_2SW^1/_4$
D	The northeast quarter of the southwest quarter	40	$NE^1/_4SW^1/_4$
E	The north half of the southeast quarter of the southwest quarter	20	$N^1/_2SE^1/_4SW^1/_4$
F	The southwest quarter of the southeast quarter of the southwest quarter	10	$SW^1/_4SE^1/_4SW^1/_4$
G	The north half of the southeast quarter of the southeast quarter of the southwest quarter	5	$N^1/_2SE^1/_4SE^1/_4SW^1/_4$
H	The southwest quarter of the southeast quarter of the southeast quarter of the southwest quarter	2.5	$SW^1/_4SE^1/_4SE^1/_4SW^1/_4$

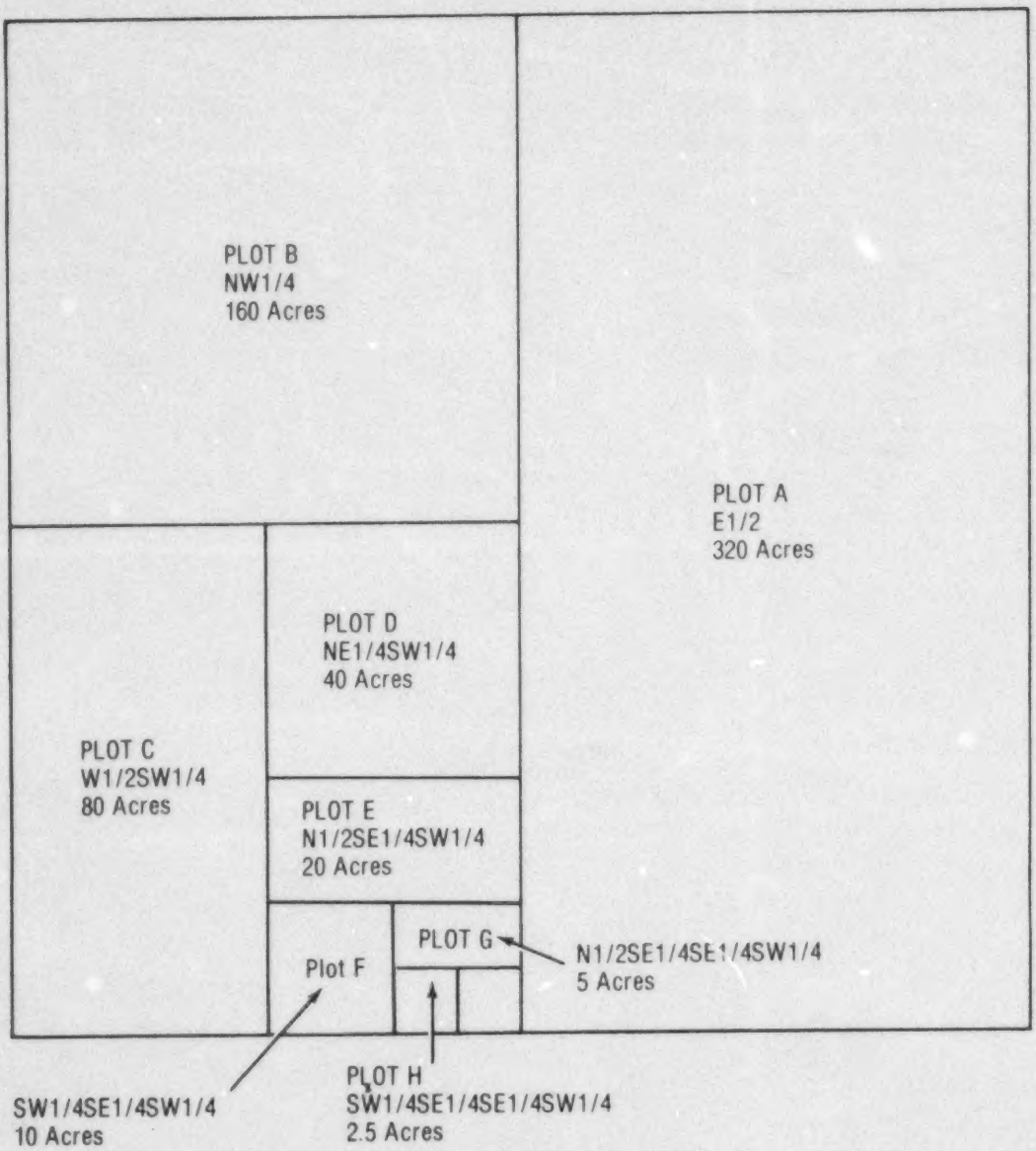
Division of a Township into Sections

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Division of a Section into Quarter Sections



Common Divisions and Subdivisions of a Typical Section of Land



C. **How is the location of individual tracts of land described for legal purposes?**

The legal description of a tract of land is based upon the range and township, section, and location within the section of the land. Several examples of a legal description are shown below:

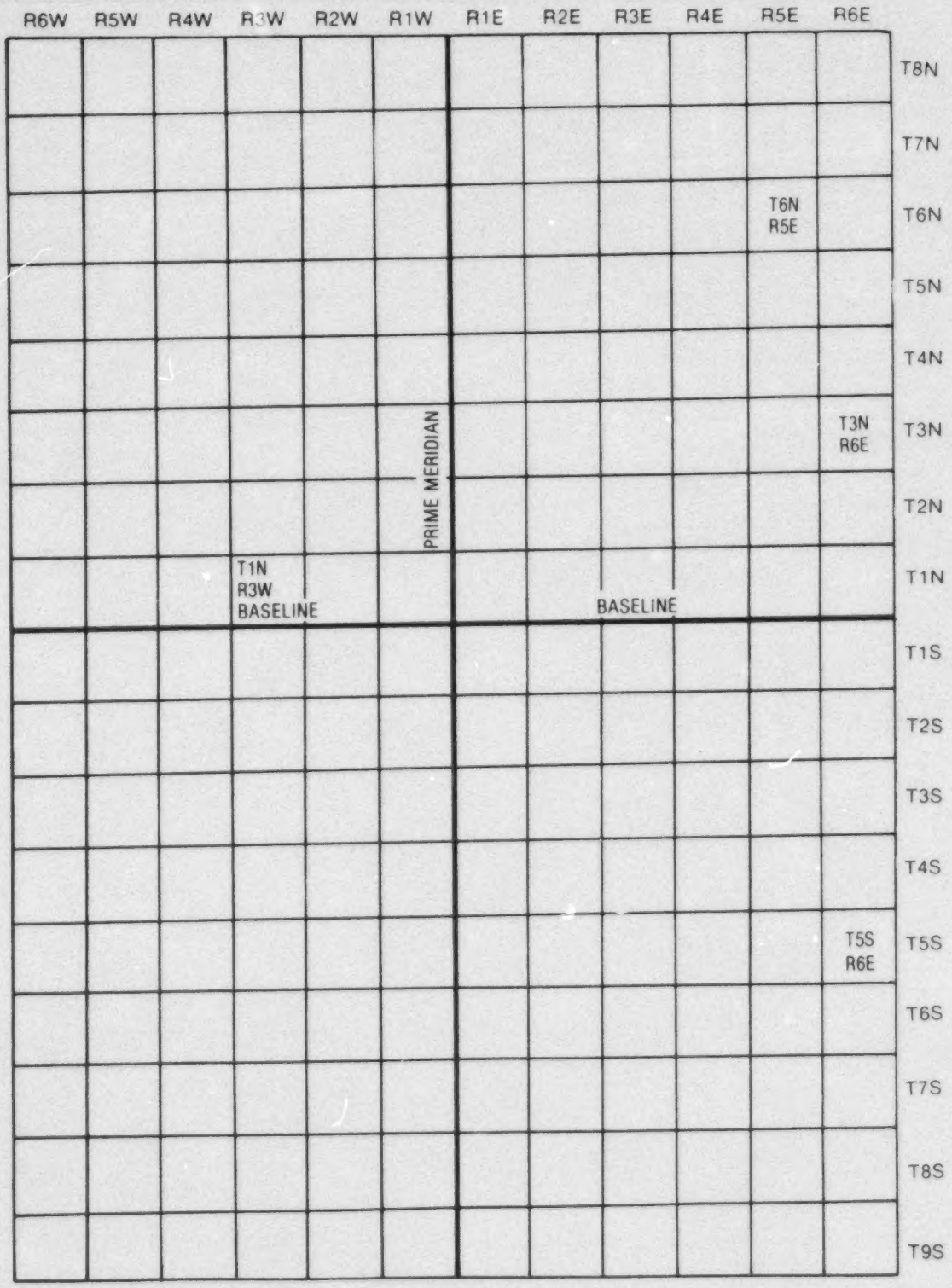
1. $E^1/_2$, Sec. 5, T 3 N, R 6 E: The east half of the fifth section of township 3 north, range 6 east.
2. $NE^1/_4$, Sec. 12, T 5 S, R 6 E: The northeast quarter of the twelfth section of township 5 south, range 6 east.
3. $N^1/_2$, $SE^1/_4$, Sec. 22, T 6 N, R 5 E: The north half of the southeast quarter of the 22nd section of township six north, range 5 east.
4. $SW^1/_4$, $NW^1/_4$, Section 14, T 1 N, R 3 W: The southwest quarter of the northwest quarter of the 14th section of township one north, range three west.

TM 17g shows the position of the townships listed in the four examples. TM 17h shows the position of the tracts described in each of the four sections.

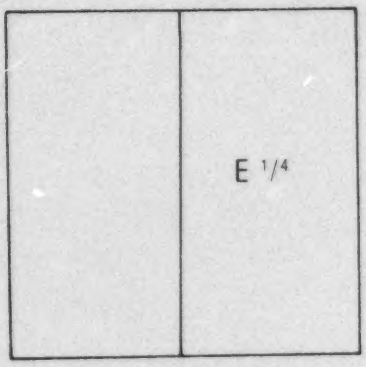
D. **How is the location of land in urban areas legally described?**

In most cases, the area of the land being described in city lots is of a much smaller acreage than the land in a field or tract in the country. In many cases, lots in the city may be only a few thousand square feet. Because of this consideration, a slightly different system is used to describe the lots within a urban or suburban area. In most cases a plot or detailed map of the area is drawn showing the exact location of streets, alleys, and lots. The location of permanent corners is carefully marked on the plot. Each lot is then described in relationship to nearby permanent corners. The description of the lot is made in terms of the length of each side and the number of degrees in the angle of each corner. The written description should be so complete that a surveyor could locate the starting point and mark the boundaries and corners of the lot by simply reading it without having to refer to a map.

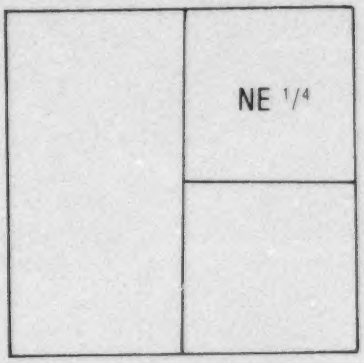
Position of Townships and Ranges



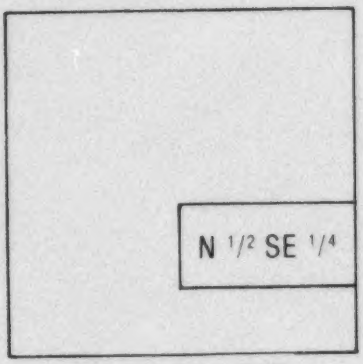
Position of Tracts within a Section



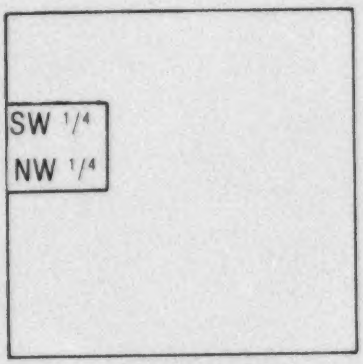
Sec 5, T3N, R6E



Sec 12, T5S, R6E



Sec 22, T6N, R5E

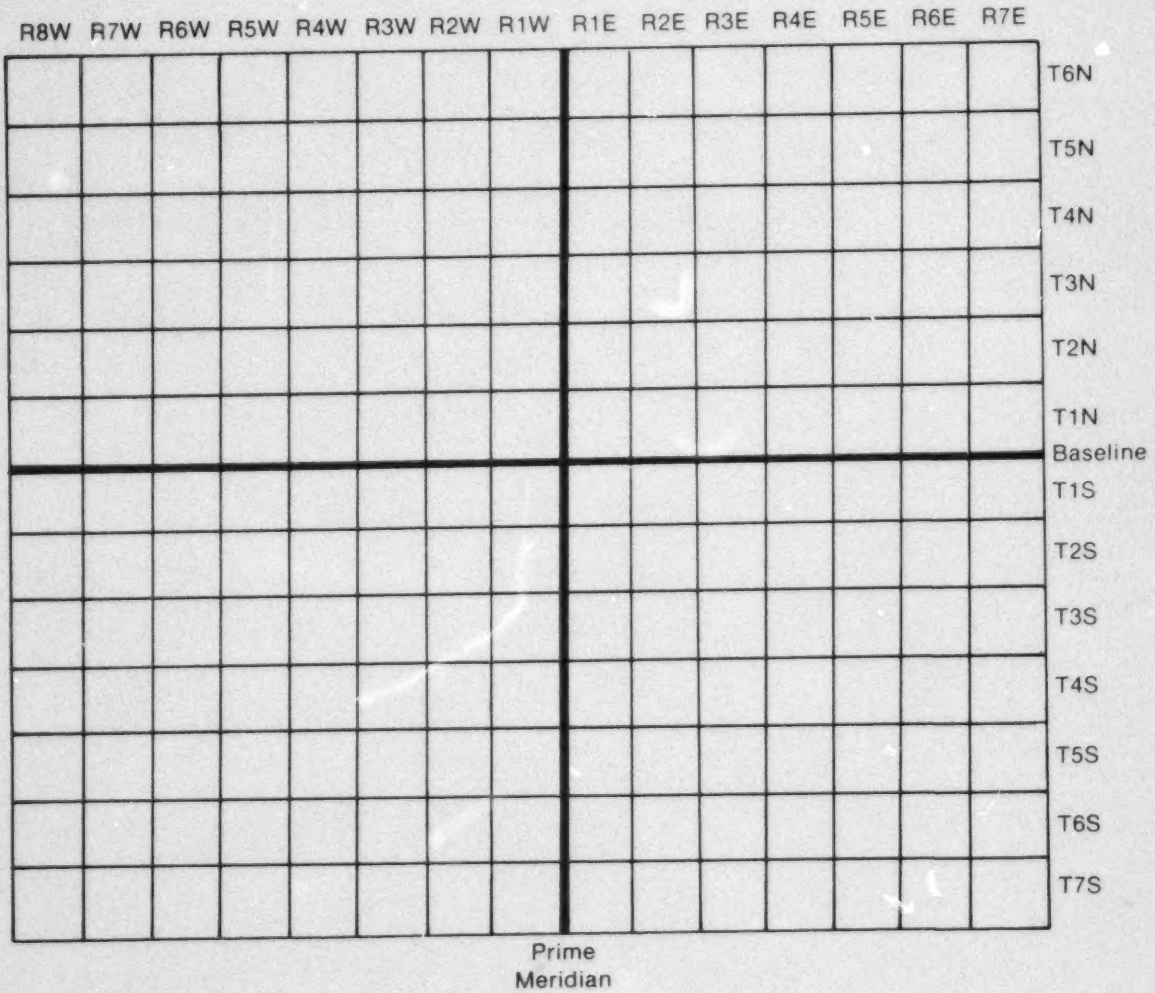


Sec 14, T1N, R3W

ASSIGNMENT SHEET 17a

On the grid below, place the number of the township listed below in the appropriate location.

1. T4N, R6E
2. T2S, R3W
3. T5N, R6W
4. T5S, R3W
5. T2N, R2E
6. T4S, R8W
7. T6N, R1E
8. T7S, R3W
9. T1N, R5W
10. T4S, R4E

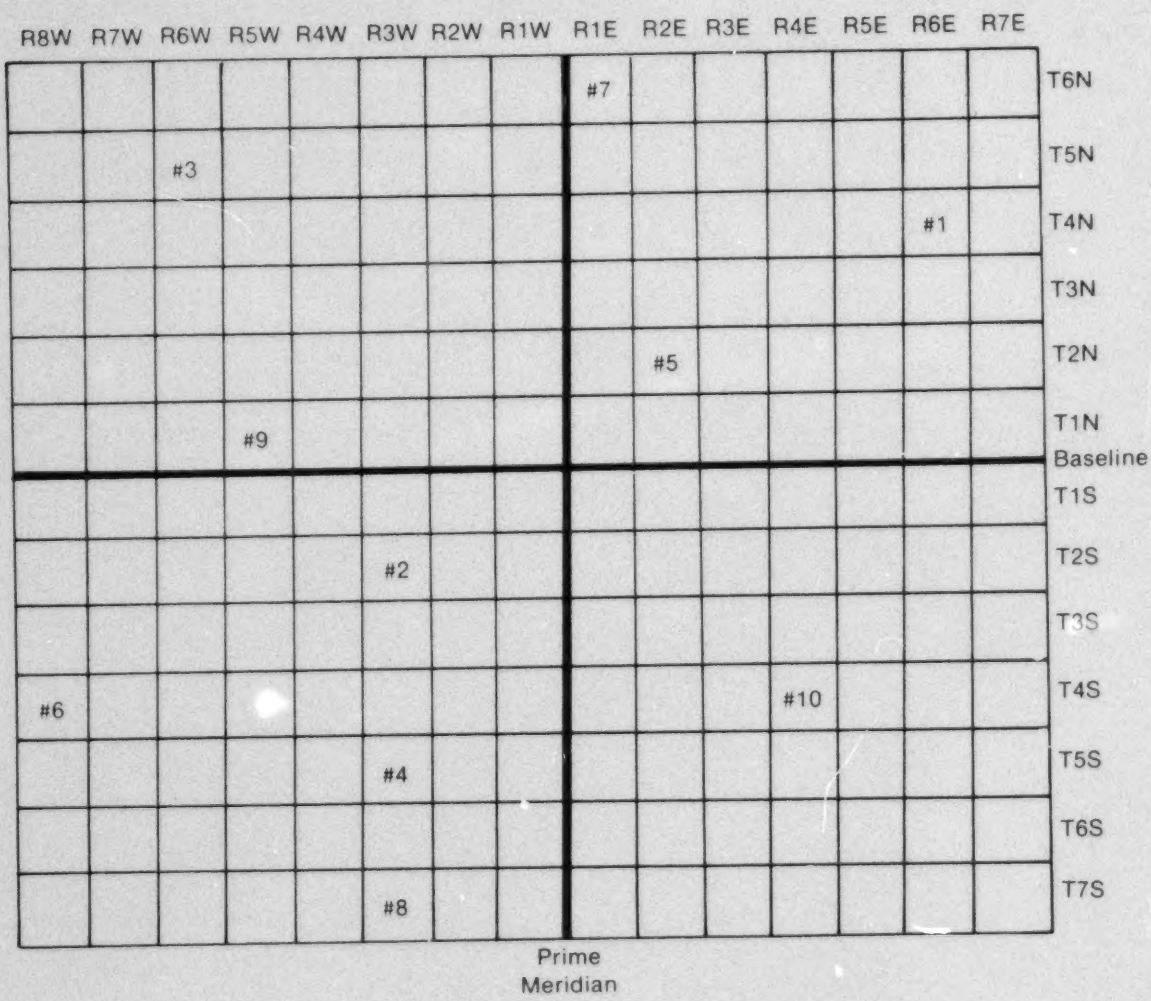


ANSWER SHEET

Assignment Sheet 17a

On the grid below, place the number of the township listed below in the appropriate location.

1. T4N, R6E
2. T2S, R3W
3. T5N, R6W
4. T5S, R3W
5. T2N, R2E
6. T4S, R8W
7. T6N, R1E
8. T7S, R3W
9. T1N, R5W
10. T4S, R4E

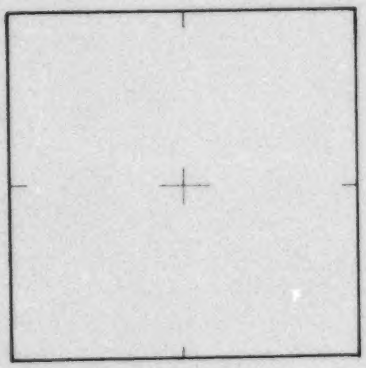


52

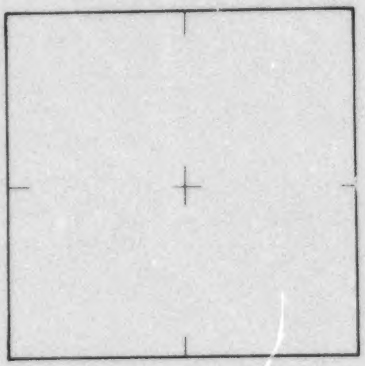
ASSIGNMENT SHEET 17b

In the sections outlined below, draw in the approximate boundaries for the legal descriptions shown below:

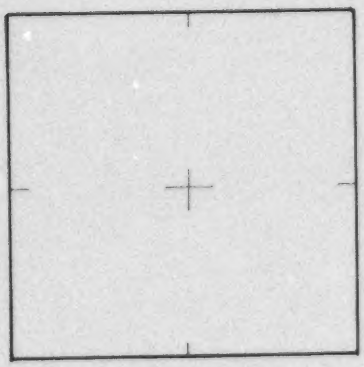
1. $E^1/_2$, Sec. 7
2. $NW^1/_4$, Sec. 12
3. $N^1/_2SE^1/_4$, Sec. 16
4. $NW^1/_4NE^1/_4$, Sec. 24



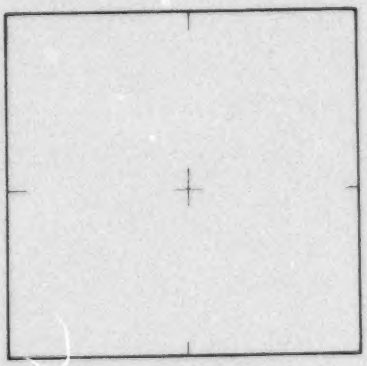
Section 7



Section 12



Section 16



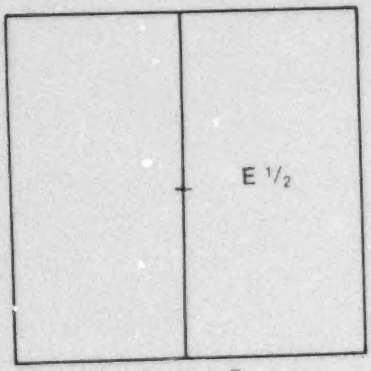
Section 24

ANSWER SHEET

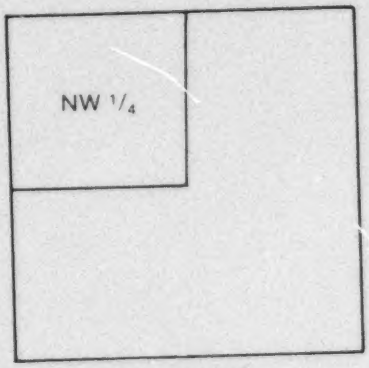
Assignment Sheet 17b

In the sections outlined below, draw in the approximate boundaries for the legal descriptions shown below:

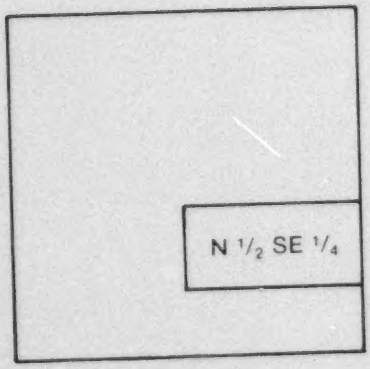
1. $E^1/_2$, Sec. 7
2. $NW^1/_4$, Sec. 12
3. $N^1/_2SE^1/_4$, Sec. 16
4. $NW^1/_4NE^1/_4$, Sec. 24



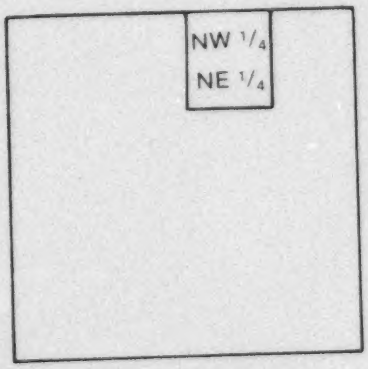
Section 7



Section 12



Section 16



Section 24

V. **Supplementary Activities:**

A. Obtain maps of local rural and urban areas. Have students locate designated areas or locate their homes and/or farms.

B. Arrange for a resource person such as a surveyor, official of the Chancery Clerk's office, etc. to speak to the class on the legal description of land.

C. Have students complete Assignment Sheets.

VI. **Supplementary Learning Aids:**

A. **Transparency Masters**

1. TM 17a. Location of Initial Points, Prime Meridians, and Base Line in Mississippi.
2. TM 17b. Initial Point Base Line, Prime Meridian, and Resulting Guide Meridians and Standard Parallels for a Typical Survey.
3. TM 17c. Subdivision of Land into Townships and Ranges.
4. TM 17d. Subdivision of a Township into Sections.
5. TM 17e. Division of a Section into Quarter Sections.
6. TM 17f. Common Divisions and Subdivisions of a Typical Section.
7. TM 17g. Positions of Townships and Ranges.
8. TM 17h. Positions of Tracts within a Section.

B. **References:**

Bouchard, Harry; and Moffiett, Francis H. **Surveying.** 5th ed. Scranton, PA: International Textbook Co., 1957.

Doane Agricultural Service, Inc. **Doane's Farm Management Guide.** 11th ed. St. Louis, MO: Doane Agricultural Service, Inc., 1976.

Legault, Adrian R.; et. al. **Surveying: An Introduction to Engineering Measurements.** Englewood Cliffs, NJ: Prentice-Hall, Inc., 1956.

Reeder, Dean. **Vocational Agriculture IV: A Curriculum Guide.** Stillwater, OK: Oklahoma State Board of Vocational and Technical Education, 1973.

Stewart, Charles L. and Voelker, Stanley W. "The Mechanics of Land Transfer," **Land: The 1958 Yearbook of Agriculture.** Washington, D.C.: U.S. Government Printing Office, 1958.

VII. **Lesson Summary:**

Key points to remember:

A. The legal description of land in Mississippi is based upon the rectangular system of measurement which was originally developed in the 1780's.

B. The legal description of land includes the township and range number, the section number, and the location of the land within the section or sections.

C. Basic areas in the rectangular system include

1. Acre — 43,560 square feet.
2. Section — 640 acres or 1 square mile, more or less.
3. Township — 36 sections or 36 square miles, more or less.

Variations in the above may exist due to corrections for the earth's curvature.

D. The description of urban areas may be based upon a detailed map showing lots.

LESSON 18

Components of Soil

I. **Introduction:**

Soil is a naturally occurring substance which is the result of thousands of years of gradual formation. For years many people have realized that the soil must be protected and used wisely. As a first step in conserving and managing soil, the components of the soil must be analyzed. These components directly affect the practices to be followed in protecting, tilling, irrigating, fertilizing, and otherwise managing any soil.

This lesson is designed to develop the student's ability to identify the components of the soil and the textural class of a soil.

II. **Objectives:**

A. **Terminal objectives.** Upon completion of this lesson, the student should be able to describe the properties of the components of the soil and to identify the general textural class of a soil.

B. **Specific objectives.** Upon completion of this lesson, the student should be able to accomplish the following:

1. Define new terms related to soil composition.
2. Describe the major components of any soil.
3. Describe the general properties of the major components of the soil.
4. Determine the textural class of a soil by simplified mechanical analysis.
5. Determine the general textural class of a soil by feel.

III. **Instructional Procedures:**

Teaching Tasks	Steps to Accomplish Tasks
A. Prepare for class.	1. Review entire lesson and determine if additional material is needed. 2. Prepare transparencies and student handouts.
B. Introduce the lesson.	1. Discuss the overall importance of the soil and the need to conserve and protect the soil. 2. Discuss the terms and definitions found under Section A, Learning Activities.
C. Identify major components of the soil and their functions.	1. Briefly list major components of soil as found in Section B of Learning Activities. 2. Discuss functions of the major components as found in Section C. 3. Refer to TM 18a and TM 18b.

58

Teaching Tasks	Steps to Accomplish Tasks
D. Identify the major textural classes of soil.	1. List and discuss the 10 major classes of soil texture. 2. Refer to TM 18c. 3. Discuss procedure for determining textural class by mechanical analysis. 4. Have students bring soil samples and perform a simplified mechanical analysis. See Job Sheet 18a and 18c. 5. Have students practice identifying soil texture by feel. See Job Sheet 18b.
E. Summarize the lesson.	1. Discuss key points to remember as found in Lesson Summary.

IV. **Learning Activities:**

A. **New terms and definitions:**

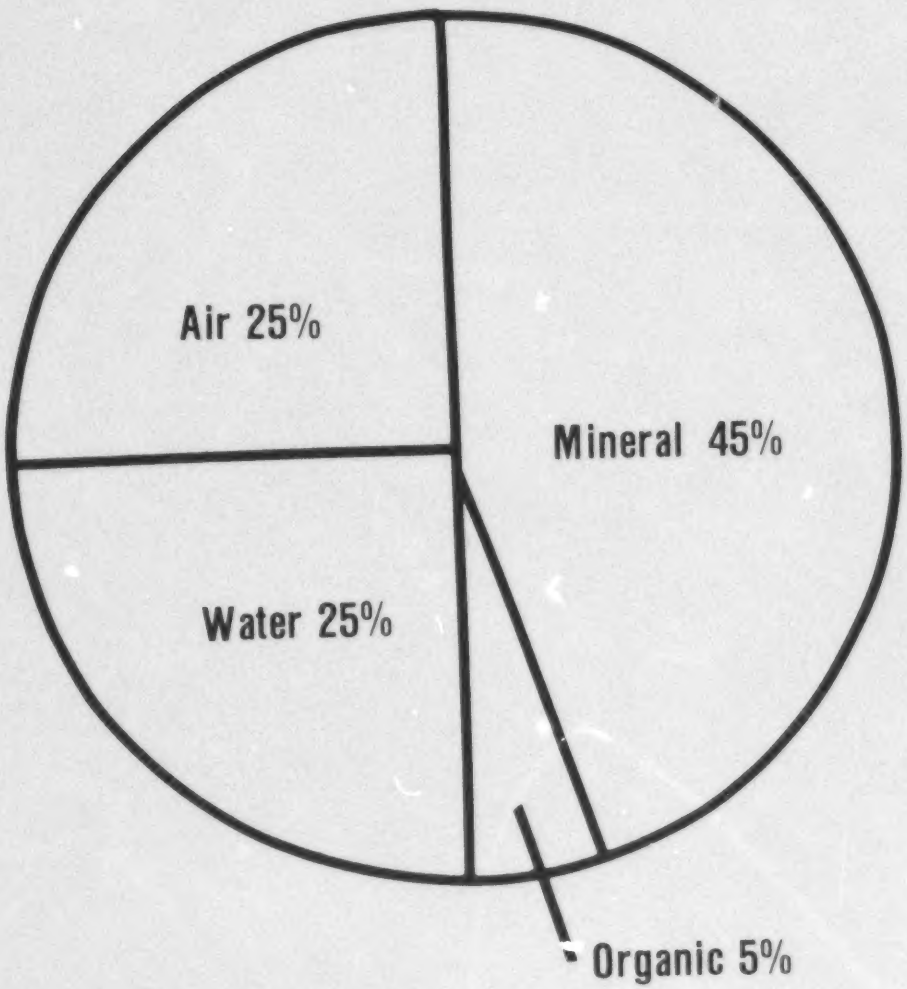
1. *Soil.* A layer of materials composed of minerals, organic material, water, and air which covers the earth's surface and is capable of supporting plant growth.
2. *Organic material.* That portion of the soil which is composed of living plants and animals and the decayed remains of plants and animals.
3. *Minerals.* That portion of the soil which is composed of non-organic materials.
4. *Texture.* The relative proportion of sand, silt and clay found in a soil.
5. *Textural class.* A method of classifying soil based upon the texture of the soil.

B. **What are the major components of any soil?**

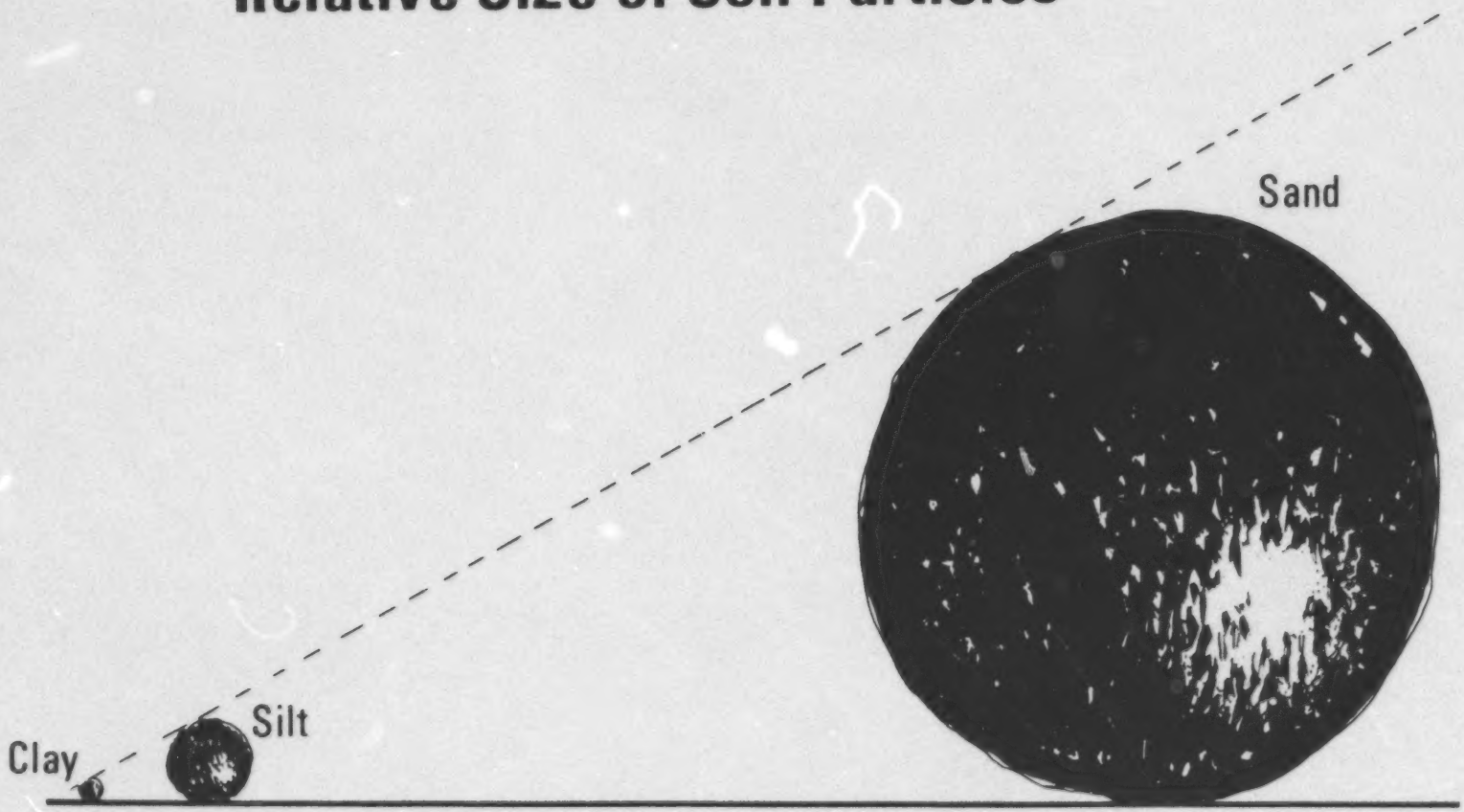
As previously defined, soil is a layer of materials composed of minerals, organic material, water, and air. Therefore, minerals, organic material, water, and air are the major components of any soil. TM 18a shows the percentage of each of these four components in an average soil. The mineral, organic material, and water components can be further broken down into the following groups:

1. *Mineral components*
   a. By chemical composition
      (1) Quartz
      (2) Feldspar
      (3) Mica
      (4) Hematite
      (5) Gibbsite
      (6) Alumnio-silicates
   b. By size (See TM 18b.)
      (1) Gravel. Particles having a diameter greater than 2 millimeters (mm).
      (2) Sand. Particles having a diameter between .05 mm and 2 mm.
      (3) Silt. Particles having a diameter between .002 mm and .05 mm.
      (4) Clay. Particles having a diameter less than .002 mm.
2. *Organic material components*
   a. Living materials
      (1) Soil macro-organisms
         (a) Rodents — moles, mice
         (b) Insects, centipedes, millipedes, and spiders
         (c) Slugs and snails
         (d) Earthworms
         (e) Plant roots

Components of the Soil and their Approximate Percentages



Relative Size of Soil Particles



83

63

64

Reproduction with permission of Oklahoma State Department of Vocational-Technical Education, Curriculum & Instructional Materials Laboratory, Stillwater, Oklahoma

(2) Soil micro-organism

(a) Nematodes

(b) Protozoa

(c) Algae

(d) Fungi

(e) Actinomycetes

(f) Bacteria

b. Plant and animal remains

(1) Peat

(2) Compost

(3) Humus

3. *Water components*

a. Capillary water. Water which is loosely attached to the surface of the soil particles. Capillary water can be absorbed by plant roots.

b. Hydroscopic water. Water which is tightly attached to the surface of each soil particle. Hydroscopic water cannot be absorbed by plants.

c. Gravitational water. Water which is not attached to any soil particle but moves downward through the cracks and airspaces in the soil.

C. **What are the properties and functions of the major components of the soil?**

In general the major properties and functions of the soil components may be summarized as follows:

1. *Mineral components.* Most of the soils in Mississippi are composed primarily of the mineral components. By weight most soils in Mississippi are at least 90 percent mineral matter and not more than 10 percent organic material. The mineral components of the soil, therefore, have a strong influence upon the soil depending upon the chemical composition and size of the minerals.

   The sand component of the soil is composed of mostly quartz which is chemically inactive. The large grains of sand do not hold water well and allow any water present to drain rapidly from the soil. In general, soils which have a high sand content are easily worked, droughty during dry weather, and low in natural fertility.

   The silt component of the soil is also composed mostly of quartz. In fact, most silt particles are actually small sand particles which are often coated with clay. Since the particles are smaller than sand, they tend to hold water and nutrients better. Silt provides some measure of plasticity to a soil. Plasticity refers to the ability of the soil to hold together.

   The clay components of the soil are composed of aluminum silicate compounds and other substances. True clay is very plastic and holds water and nutrients very well. Clay soils are usually more difficult to work and drain very slowly. With the exception of the soils found in the Blackland Prairie of Mississippi, most of the clay found in soils in the state is of the kaolinite type. Clay provides a soil with an ability to hold fertilizer nutrients in place until the plant roots can absorb them.

2. *Organic materials.* While the organic materials found in most Mississippi soils are usually less than 10 percent of the weight of the soil, their influence on the soil can be very important. As previously noted organic materials in the soil are divided into two major groups: the living plants and animals, and the decomposed remains of plants and animals.

   The living plants and animals found in the soil may have many beneficial effects on the soil itself. Animals such as moles, field mice, and earthworms penetrate the soil with tunnels which help to aerate the soil and improve drainage. Insects and insect-like animals such as ants, termites, centipedes, and others partially decompose dead plant and animal tissue. Fungi, bacteria, nematodes, and other microscopic plants and animals further decompose plant and animal tissue and thereby enrich the soil. The roots of living plants aerate the soil and serve as a future source of organic material for decomposition.

The decomposed remains of plants and animals in the soil also improve the quality of the soil. The effects of organic material are dependent upon how well the material has decomposed. Humus is organic material which has completely decomposed to the point that the material is no longer recognizable. Humus tends to have some of the physical characteristics of clay particles in that the humus particles hold moisture and nutrients very well. However, humus, unlike clay, does not bind the soil together but loosens the structure of the soil. Humus and other decomposed organic materials also serve as a natural source of nitrogen.

In general, a high organic material content gives the soil the following characteristics:

a. Makes the soil porous.

b. Supplies nitrogen to growing plants.

c. Helps hold water in the soil.

d. Furnishes food for soil organisms.

e. Serves as a storehouse for mineral nutrients.

f. Minimizes the loss of nutrients.

g. Stabilizes the soil structure.

3. *Soil water and air.* These two components of the soil are directly related to each other and occupy the same space — the small holes or pores found between the mineral and organic materials in the soil. Both air and water are necessary for plant root growth. The amount of air found in the soil is dependent upon the amount of water present. After a heavy rain the large and small spaces or pores in the soil are usually filled. Normally the larger pores will then empty their water while the smaller pores will hold the water in them. The number of large and small pores in the soil is directly related to the texture of the soil. Sandy soils are very porous while clay soils have fewer pores. As a result, the sandy soils lose much of the water which enters them, whereas, clay soils retain much of their water.

   In addition to supplying itself to the plants, water also serves as a means of transporting nutrients from the soil to the plant roots. Soil air supplies oxygen which is necessary for plant growth.

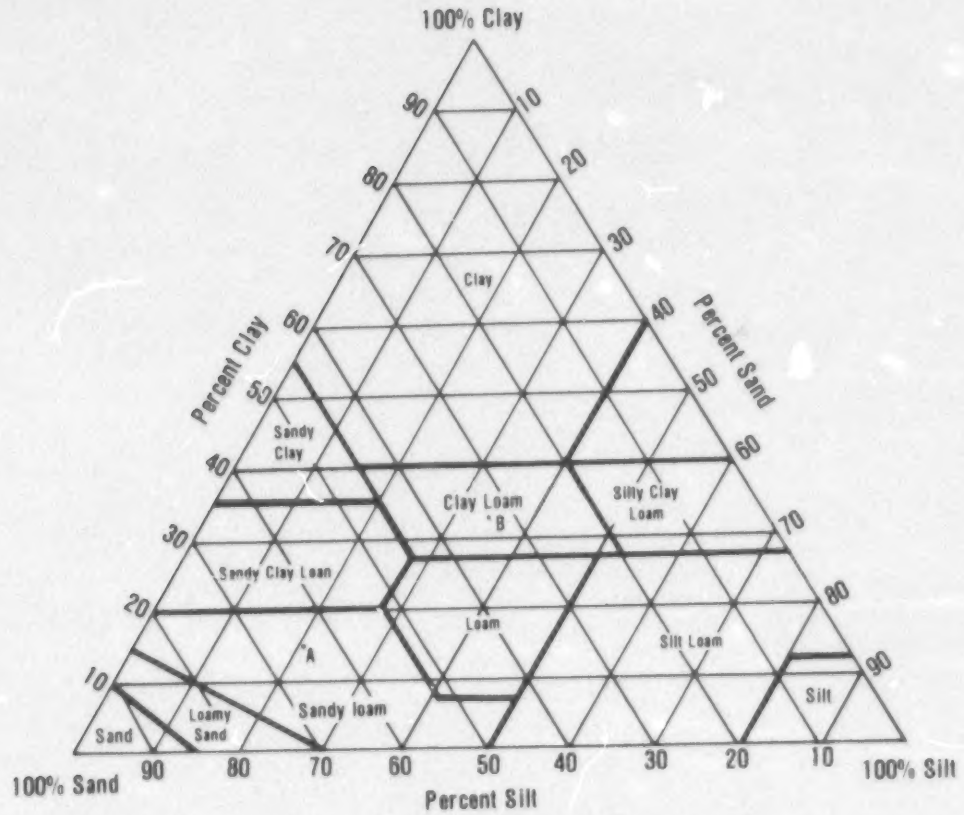
D. **What are the major textural classes of soils?**

As previously noted the textural class of a soil is determined by the amount of sand, silt and clay found in the soil. There are ten classes of soil texture which are defined as follows:

1. *Sands.* Soils containing 80 to 100 percent sand and 0 to 05 percent clay and/or silt.
2. *Loamy sands.* Soils which contain 70 to 90 percent soil, 0 to 15 percent clay, and 0 to 30 percent silt.
3. *Sandy loams.* Soils which contain 43 to 85 percent sand, 0 to 50 percent silt, and 0-20 percent clay.
4. *Loams.* Soils which contain 23 to 52 percent sand 28 to 50 percent silt, and 7 to 27 percent clay.
5. *Silt loams.* Soils which contain 0 to 50 percent sand, 50 to 88 percent silt, and 0 to 27 percent clay.
6. *Clay loams.* Soils which contain 20 to 45 percent sand, 15 to 53 percent silt, and 27 to 40 percent clay.
7. *Silty clay loams.* Soils which contain 20 to 45 percent sand, 15 to 53 percent silt, and 27 to 40 percent clay.
8. *Sand clay loams.* Soils which contain 45 to 80 percent sand, 0 to 28 percent silt, and 20 to 35 percent clay.
9. *Clays.* Soils which include 0 to 45 percent sand, 0 to 45 percent silt, and 40 to 100 percent clay. Some clays may be classified as silty clays or sandy clays depending upon the amount of sand or silt present.
10. *Silts.* Soils containing 0 to 20 percent sand, 0 to 12 percent clay, and 87 to 100 percent silt.

TM 18c shows a diagram which is used to determine the textural class of a soil. The lines which run horizontally in the triangle represent the percentage of clay. The lines which slant to the left represent the percentage of sand and the lines which slant to the right represent the percentage of silt. Point A on the triangle represents a soil composed of 65 percent sand, 20 percent silt, and 15 percent clay and classified as sandy loam. Point B represents a soil which is composed of equal parts (33 percent) of sand, silt, and clay and classified as a sandy loam.

Guide to Determining Textural Classes of Soil



E. **How can the textural class of a soil be determined?**

Soil scientists use a process called mechanical analysis to determine the precise amounts of sand, silt, and clay in a soil. Several processes have been devised to yield exact results. The basic principle on which all of these processes operate deals with the settling of soil particles in a solution of water. In mechanical analysis the soil is dried and pulverized. An exact amount of soil is then added to a solution of water and Calgon (an agent which breaks the soil up into its individual particles). The solution is then shaken until all soil particles are in suspension. Sand particles settle from the suspension in approximately 40 seconds. Silt particles will settle out in an hour. By taking measurements at these times, the amount of clay can be calculated. (Some of the clay particles can remain in suspension for long periods of time.)

With practice, a person can determine the general texture of a soil by feeling it. The physical properties of the three general classes of soil follow:

1. *Coarse textured soils.* Very sandy soils. Feels extremely gritty when rubbed between the fingers. Coarse textural soils include loamy sands and sands.
2. *Medium textured soils.* Silty or loamy soils. Feels floury or slightly gritty when rubbed between the fingers, but will not ribbon out like clay. Medium textured soils include sandy loams, loams, silt loams, silts, sandy clay loams, sandy clays, clay loams, and silty clay loams.
3. *Fine textured soils.* Clay soils. Feels very sticky or plastic when wet. Will ribbon or leaf out if rubbed between the fingers. Fine textured soils include silty clays and clays.

JOB SHEET 18a

Simplified Mechanical Analysis of Soils

Materials needed: Soil sample

One quart glass jar with lid (Sides and bottom of jar should be straight and level.)

Measuring ruler or tape (preferably metric)

Calgon solution — (6 tablespoons Calgon per 1 quart of water. Calgon can be purchased at any supermarket.)

Measuring cups and spoons

Procedure:

1. Place approximately one half cup of dry, pulverized soil into the quart jar. Tap jar gently to settle. Measure the depth of the soil in the jar. Students may find it easier to use the metric system and make all measurements in millimeters.
2. Add 5 tablespoons of Calgon solution and 3 $^1/_2$ cups of water to the jar. Cap the jar and shake vigorously for 5 minutes.
3. Place jar on a level surface and let stand undisturbed for 1 minute. Measure the depth of the accumulated sand. At the end of 1 hour, measure the depth of the accumulated silt. **Do not disturb the jar during the waiting period.**
4. Calculate the percentages of sand, silt, and clay present in the soil using the following formulas:

   a. Percentage of sand = $\frac{\text{Depth of sand layer} \times 100}{\text{Original depth of soil}}$

   b. Percentage of silt = $\frac{\text{Depth of silt layer} \times 100}{\text{Original depth of soil}}$

   c. Percentage of clay = 100 - (percentage of sand + percentage of silt)

   Example:

   Original depth of soil 23 mm.

   Depth of sand layer 9 mm.

   Depth of silt layer 10 mm.

   Percentage of sand = $\frac{9 \text{ mm} \times 100}{10\text{mm}} = 39\%$

   Percentage of silt = $\frac{10 \text{ mm} \times 100}{23 \text{ mm}} = 43\%$

   Percentage of clay = 100% - 82% = 18%

5. After percentages of sand, silt, and clay are determined, the textural class of the soil can be determined by using the textural triangle found in TM 18c. In this case the soil would be classified as a loam.

JOB SHEET 18b

Determining Soil Texture by Feel

Materials needed: Several samples of various textured soil

Towels to wipe hands

Procedure:

1. With dry hands, take a dry sample of the soil. Note the presence or absence of clods and the degree of hardness of any clods. Note the overall feel of the soil: gritty, floury, smooth, etc.
2. Apply a small amount of water to the sample and work the sample into a ball. Note if the ball stains the fingers, holds together under pressure, and can be worked into a ribbon.
3. Evaluate findings using following criteria:
   a. Sands

      Dry: Looks loose and single-grained; feels gritty.
      Moist: Forms easily crumbled ball.

   b. Loamy sands

      Dry: Silt or clay covers sand particles; feels loose and gritty.
      Moist: Feels gritty, forms easily crumbled ball; stains fingers slightly.

   c. Sandy loams

      Dry: Clods are easily broken; sands can be seen and felt.
      Moist: Feels moderately gritty; forms ball that can be handled carefully; definitely stains fingers.

   d. Loams

      Dry: Clods moderately hard to break; feels mellow, somewhat gritty.
      Moist: Feels neither very gritty nor very smooth; forms a firm ball; stains fingers.

   e. Silt loam

      Dry: Clods are difficult to break; when clods are pulverized, they feel smooth, soft, and floury; shows fingerprints.
      Moist: Has smooth or slick "buttery" or "velvety" feel; stains fingers.

   f. Clay loam

      Dry: Clods are very difficult to break with fingers.
      Moist: Has slightly gritty feel; stains fingers; ribbons fairly well.

   g. Clay

      Dry: Clods cannot be broken without extreme pressure.
      Moist: Feels quite plastic and usually sticky when set; stains fingers. (Silty clays feel smooth; sandy clays feel gritty.)

VI. **Supplementary Learning Aids:**

A. **Transparency Masters**

1. TM 18a. Components of the Soil and Their Approximate Percentages.
2. TM 18b. Relative Size of Soil Particles.
3. TM 18c. Guide to Determining Textural Classes of Soils.

B. **References:**

Agribusiness Education Service. **Soils: Land Capability Classes.** Montgomery, AL: Alabama State Department of Education, 1976.

Buekman, Harry O. and Brady, Nyle C. **The Nature and Properties of Soils.** 7th ed. London, Eng.: The Macmillian Co., 1969.

Jacks, L.P. and Hamilton, J.R. **Basic Principles of Soil Science.** Mississippi State, MS: Research and Curriculum Unit, Reprinted 1978.

Miller, Larry E. **Physical Features of Soil.** Blacksburg, VA: VPI&SU, 1974.

Palmertree, Hiram D. et. al. **Instructions on Land Judging in Mississippi.** Bul. No. 679. Mississippi State, MS: Miss. Cooperative Extension Service, 1977.

Patton, Bob. **Vocational Agriculture II: A Curriculum Guide.** Revised by Pete Braker. Stillwater, OK: Oklahoma State Department of Education, 1975.

Russell, M.B. "Physical Properties." **Soil: The 1957 Yearbook of Agriculture.** Washington, D.C.: United States Department of Agriculture, 1957.

Vocational Instructional Services. **Basic Vo-Ag I.** College Station, TX: Texas A&M University, n.d.

VII. **Lesson Summary:**

Key points to remember:

A. Soil substance is the result of thousands of years of gradual development and must be continually protected and conserved since almost all of our food comes from the soil.

B. Soil is a mixture of minerals, air, water, and organic materials.

C. Mineral components of soil are classified by size as being either gravel, sand, silt, or clay.

D. Organic material in the soil includes living plants, animals and micro-organisms, and decayed remains of plants and animals.

E. Briefly stated the four components of the soil and their functions include the following:

1. Soil air. Furnishes air to plant roots.
2. Soil water. Furnishes water for growth and transports minerals.
3. Soil minerals. Furnish nutrients for plant growth.
4. Soil organic materials. Improve texture, water holding capacity, and nutrient levels of the soil.

F. The texture of a soil strongly influences the management practices to be followed.

LESSON 19

Properties of Soil

I. **Introduction:**

In addition to the components which make up a soil, several properties of that soil play an important part in determining the best use and management of that soil. Some of these properties are directly related to the texture of the soil while others are related to topography, climate, native vegetation, and past uses of the soil.

This lesson is designed to develop the student's knowledge of some of the general properties of a soil and the ability to correctly estimate these properties for a given soil.

II. **Objectives:**

A. **Terminal objective.** Upon completion of this lesson, the student should be able to describe general properties of soils and to identify these properties in a given soil.

B. **Specific objectives.** Upon completion of this lesson, the student should be able to:

1. Define new terms related to soil properties.
2. Describe the common types of soil structure.
3. Describe the three layers of a soil profile.
4. Describe factors which influence internal and surface drainage of a soil.
5. Identify the three soil layers of a given soil.
6. Identify the structure of a given soil
7. Identify the internal drainage ability of a given soil.
8. Determine the slope of a given soil surface.

III. **Instructional Procedures:**

Teaching Tasks	Steps to Accomplish Tasks
A. Prepare for class.	1. Review entire lesson and determine if additional material is needed. 2. Prepare transparency masters and student handouts.
B. Introduce the lesson.	1. Discuss the importance of studying soil properties as related to soil management. 2. Discuss terms and definitions found in Section A of Learning Activities.
C. Develop ability to identify structural types of soil.	1. Discuss general information on soil structure as found in Section B of Learning Activities. 2. Describe characteristics of various types of soil structures. Refer to TM 19a. 3. Provide samples of soil structure common in local area.

Teaching Tasks	Steps to Accomplish Tasks
D. Develop ability to identify the three main layers of a soil profile.	1. Describe three main layers of soil profile. Use TM 19b. 2. Take students to nearby ditch, road cut, or pit and have students identify these layers.
E. Develop ability to evaluate internal drainage ability of soil.	1. Discuss material found in Section D of Learning Activities. 2. Discuss factors to be used in determining internal drainage. 3. Demonstrate procedures as found in Job Sheet 19a. 4. Have students determine internal drainage ability of local soils.
F. Develop ability to evaluate surface drainage of soil.	1. Discuss material related to surface drainage as found in Section E of Learning Activities.

Teaching Tasks	Steps to Accomplish Tasks
G. Develop ability to determine surface slope of a soil.	1. Demonstrate procedure in Job Sheet 19b. 2. Allow students to practice measuring surface slope using slope finders. 3. Have students practice estimating slopes without instruments.

IV. LEARNING ACTIVITIES:

A. New terms and definitions

1. *Soil structure*. The arrangement of the individual soil particles into clumps or aggregates.
2. *Soil profile*. A vertical section of a soil which shows the different layers of soil formation from the topsoil to the parent material from which the soil developed.
3. *Internal drainage*. The ability of a soil to allow water to move downward through the various soil layers.
4. *Surface drainage*. The ability of a soil to shed water from its surface. Surface drainage is directly related to the slope of the soil surface.
5. *Droughty*. A term used to describe soils which allow too much water to drain through and do not retain enough water for plant growth.
6. *Surface slope*. The number of feet of fall or drop per 100 feet of horizontal distance.
7. *Soil tilth*. A term used to describe the condition of the soil structure. Soils which have a good structural pattern and are easy to work are said to have good tilth.
8. *Parent material*. The original mineral or rock material from which the upper layers of the soil profile develop.

B. What are the common types of soil structure?

The structural arrangement of the soil particles plays an extremely important role in the management of a soil. Structure of a soil can be controlled somewhat through the method of cultivation and timing of cultivation, and by regulating the amount of organic material in the soil.

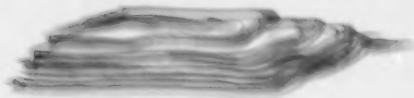
Soils with a good structure contain a large number of crumbs or aggregates which fall apart easily from each other into smaller pieces. This type of structure permits deeper plant root growth and an expansion of plant roots over a wider area of the soil.

Various types of soil structure are described below and illustrated in TM 19a.

Single grain structure is not illustrated, but is very typical of soils containing mostly sand. Actually there is no structure to these soils at all. Water drains through these soils rapidly and soils with single grain structure are usually droughty.

Soil Structure

Crumb



Platy

Granular

Angular Blocky

Subangular Blocky

Prismatic

Columnar

Reproduction with permission of Oklahoma State Department of Vocational-Technical Education, Curriculum & Instructional Materials Laboratory, Stillwater, Oklahoma

C. What are the three main layers of a soil profile?

Over several thousand years, the soil develops three well-defined layers. These layers compose a soil profile which extends from the soil surface to the parent material. Depth of a soil profile may range from less than 10 inches to six to seven feet or more. Some soils in Mississippi have soil profiles which extend to depths of twenty feet or deeper.

In TM 19b, a typical soil profile is illustrated. Each of the three major layers is described below.

The *topsoil* or *A horizon*, as soil scientists refer to it, is the uppermost layer of a soil and contains most of the organic material, plant roots, and nutrients found in the soil. The topsoil is usually the only portion of the profile which is normally tilled and cultivated. The color of the topsoil may vary from dark black to red. Usually the topsoil can be distinguished from lower levels by its darker color. In cultivated soils, erosion may have removed some or all of the topsoil.

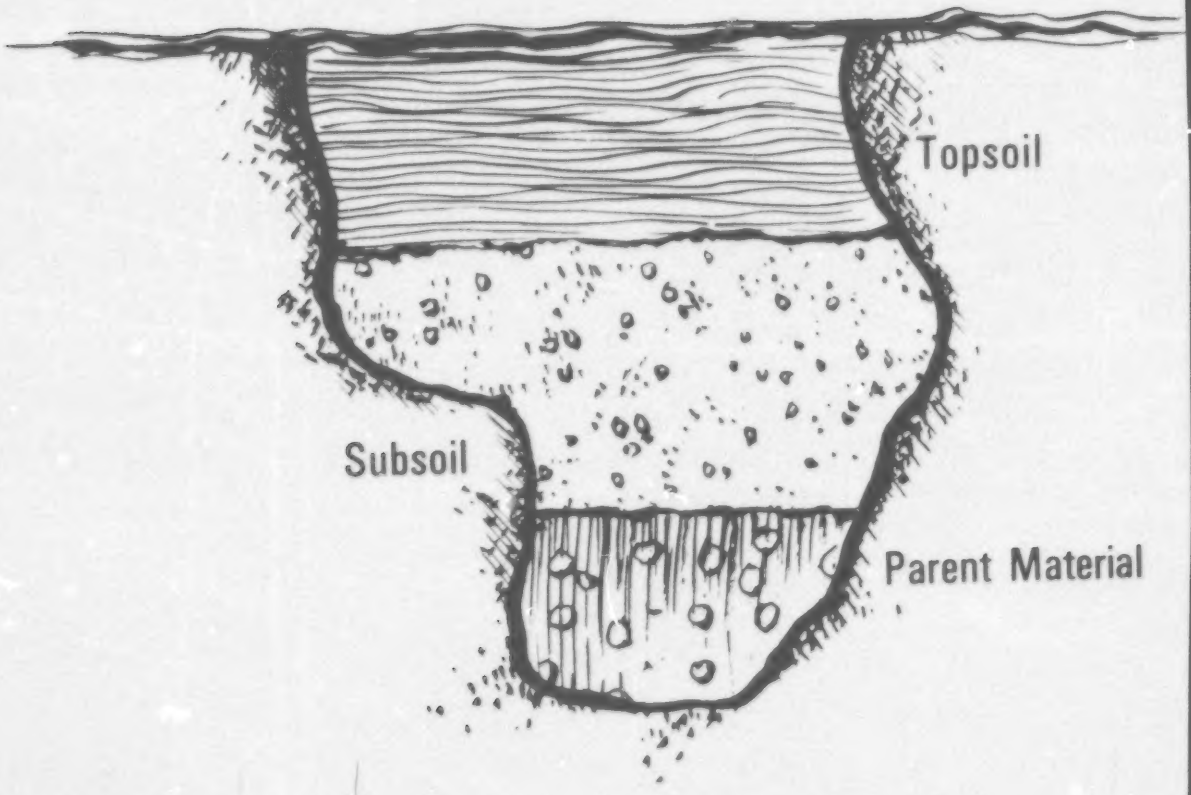
The topsoil is the most important layer of soil from an agricultural viewpoint. For crop production purposes, the topsoil should be of medium to coarse in texture and should have a granular or crumb structure.

The *subsoil* or *B horizon* also plays a role in determining the usage of a soil. Generally speaking, the subsoil will be lighter in color than the topsoil and will contain a higher percentage of clay. Since plant roots can extend into the subsoil, it should be of a texture and structure which permits root growth. A medium texture which allows excess water to drain while holding some water for plants is best.

In some subsoils, hardpans or layers of tightly pressed soil may occur. These layers can greatly restrict the movement of roots, air, and water and, in effect, cause the soil to be shallow. Traffic hardpans are caused by cultivation and tillage and are usually only a few inches in thickness. These man-made hardpans can be broken up by deep plowing. Genetic hardpans, on the other hand, result from natural causes and can be several feet in thickness. Little can be done to break up these hardpans to allow root growth and water drainage through them.

The *parent material* or *C horizon* is that material below the subsoil and topsoil layers from which these layers developed. Under most conditions, the parent material does not play an important role in determining the usage of the soil since it is not disturbed by plant roots or cultivation and tillage.

Soil Profile



109

Reproduction with permission of Oklahoma State Department of Vocational-Technical Education, Curriculum & Instructional Materials Laboratory, Stillwater, Oklahoma

D. What factors influence the internal drainage ability of a soil?

Internal drainage of a soil is vital for proper plant growth. A good soil for cultivation must shed excess water after a heavy rain and at the same time hold sufficient water for plant growth until the next rain. Internal drainage determines to a great extent the highest usage for which a soil can be used and the management practices for that soil. Internal drainage is influenced by the following factors:

1. *Soil texture.* Soils which have a medium to coarse texture provide the best internal drainage. Soils which are mostly sand, however, allow water to drain through too quickly and do not hold plant nutrients. Soils having a high content of clay do not allow water to drain easily and may remain wet for long periods after heavy rains. This may prevent field operations such as tillage, cultivation, and harvesting.

2. *Soil structure.* Soils having a crumb or granular structure in both topsoil and subsoil drain more rapidly than soils having a prismatic, columnar, or platy structure. In evaluating the structure of a soil, one should examine both topsoil and subsoil layers. The subsoil plays an important role in determining the internal drainage ability of a soil.

3. *Hardpans.* Layers of compacted soil in the subsoil greatly influence the ability of the soil to drain internally.

4. *Organic material.* The amount of organic material found in the soil directly affects the drainage. In sandy soils, organic material increases the water-hold capacity, while in clay soils, it provides more air space and improves internal drainage.

E. What factors affect the surface drainage ability of a soil?

Surface drainage is mostly influenced by the slope of the soil surface. As the slope of the soil increases, the speed of surface drainage increases. Problems of erosion can occur if the surface slope is so steep that water running off removes topsoil. Other factors which influence surface drainage can include vegetation, organic material on the surface, and mechanical practices such as terracing.

JOB SHEET 19a

Evaluating Internal Drainage of a Soil

Materials needed: Shovel or spade

Procedure:

1. To determine the internal drainage ability of a soil, a person must first locate a site such as a ditch bank, pit, or road cut at which the topsoil and subsoil can be observed to a depth of at least 3 feet.
2. Using the shovel or spade, expose a fresh area of topsoil and subsoil so that color and texture can be determined.
3. Evaluate the internal drainage ability of the soil using the following criteria:
   a. *Rapid:* These soils have a sandy topsoil and subsoil. Color may range from light to dark depending upon organic material and mineral content. Bright red or rust colors are common. Very little clay content is present, and both topsoil and subsoil will have a single grain or granular structure.
   b. *Moderate:* These soils have a clay loam subsoil with a granular texture. Texture is open enough to allow water and air to move freely. The subsoil may contain a few mottles. Mottles are off-color flakes of soil which may be olive to gray in color.
   c. *Slow:* These soils have a more dense subsoil which has a higher clay and silt content. Structure is more massive and the texture is finer than in soils having moderate internal drainage. More gray mottles are present and concretions or hardened mineral lumps may be present. Color of the subsoil will be much more drab than the brighter colors found in soils having rapid to moderate internal drainage.
   d. *Very slow:* These soils will have a dense heavy clay texture and a platy or massive structure in the subsoil. Considerable numbers of mottles will be found in the subsoil. Color may range from dark black to almost white. Hardpans may be located in the subsoil.

JOB SHEET 19b

Determining Surface Slope of a Soil

Materials needed: 2 wooden stakes-4 feet tall

Hammer or mallet

1-8$^1/_2$" by 11" piece of plywood

1-Slope finder chart

1-String, 12 inches long

3-Small nails or brads

1-Small weight

Glue

Transparent plastic wrap

Procedure:

1. Mount slope finder chart on plywood using glue.
2. Cut an opening for a hand hold or attach a handle.
3. Cover slope finder with plastic wrap.
4. Drive brads or nails into sighting points on chart and into point of attachment.
5. Hang a small weight from point of attachment.
6. At the steepest point on a given area drive on stake.
7. Pace off 100 feet (approximately) either directly up or directly down the slope.
8. Drive the second stake to the same depth as the first.
9. Using the two brads or nails as sighting pins, sight directly from the top of one stake to the other.
10. When string and weight come to rest, hold the string in place on the degree line and read the slope.
11. Interpret slope as follows:

    Nearly level—Less than 2% slope

    Gently sloping—2-5% slope

    Moderately sloping—5-8% slope

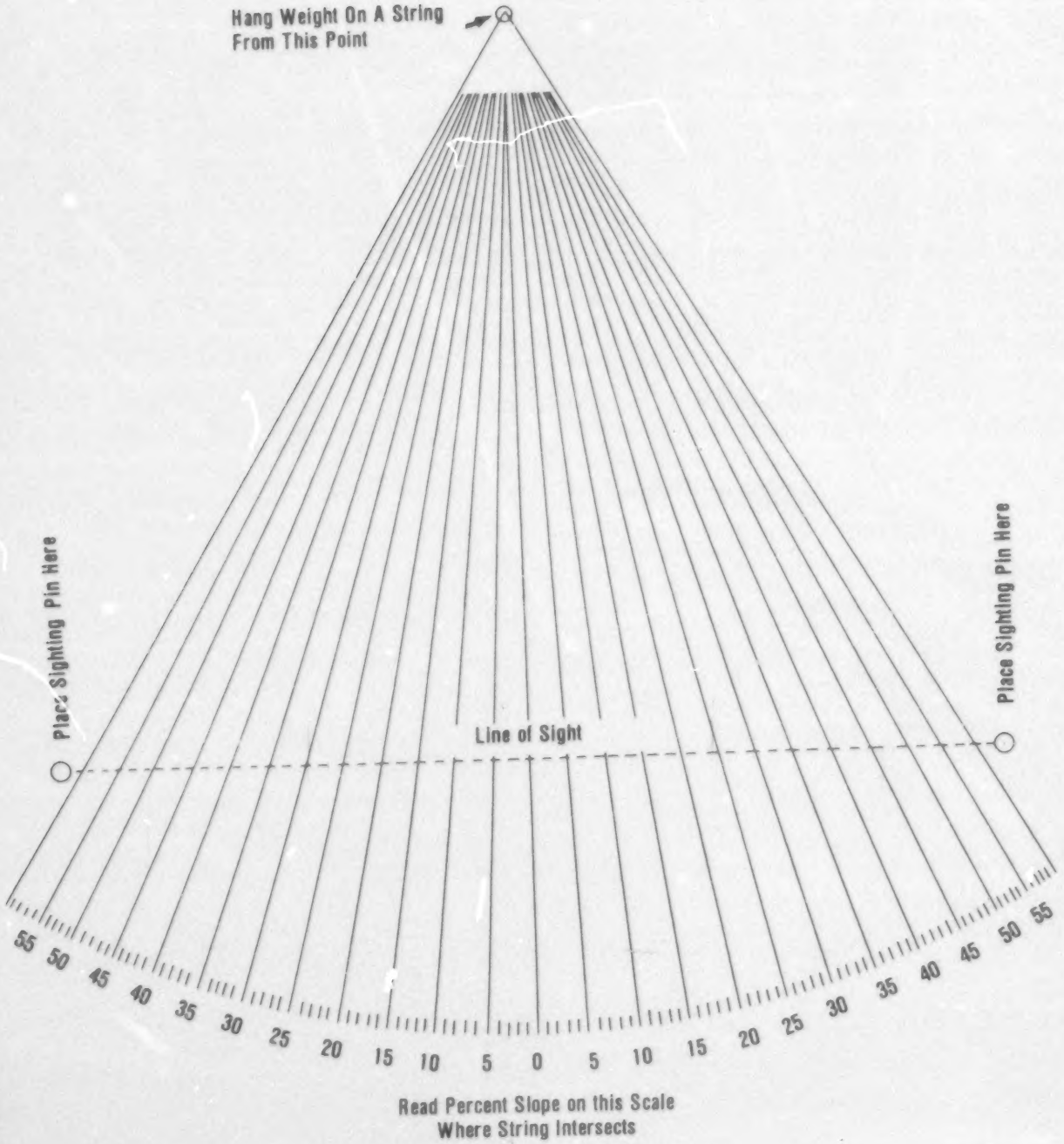
    Strongly sloping—8-12% slope

    Steep—12-17% slope

    Very steep—over 17% slope

    With practice, you should be able to estimate the slope of a given tract of land without the aid of this device.

Slope Finder


Hang Weight On A String
From This Point
Place Sighting Pin Here
Line of Sight
Place Sighting Pin Here
55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55
Read Percent Slope on this Scale
Where String Intersects

V. **Supplementary Activities:**

A. Conduct a simplified soil juding contest. Have students determine the texture, structure, and slope of a given soil.

B. Have students prepare a report on a soil on their home, farm or other site. The report will include the depth of the three layers of the soil, texture and structure of each layer, internal drainage of each layer, and the surface slope.

VI. **Supplementary Learning Aids:**

A. Transparency Masters

1. TM 19a. Soil Structure
2. TM 19b. Soil Profile

B. References

Agribusiness Education Service. **Soils: Land Capability Classes.** Montgomery, AL: Alabma State Department of Education, 1976.

Carter, L. S. and Leighty, R. V. **Soils Manual for Land Judging.** San Luis Obispo, CA: Vocational Education Productions, n.d.

Jacks, L. P. and Hamilton, J. R. **Basic Principles of Soil Science.** Mississippi State: Research and Curriculum Unit, Reprinted 1978.

Palmertree, Hiram D. et. al. **Instructions on Land Judging in Mississippi.** Bul. No. 679. Mississippi State, MS: Mississippi Cooperative Extension Service, 1977.

Patton, Bob. **Vocational Agriculture II: A Curriculum Guide.** Revised by Pete Braker. Stillwater, OK: Oklahoma State Department of Education, 1975.

Vocational Instructional Services. **Basic Vo-Ag I.** College Station, TX: Texas A&M University, n.d.

VII. Lesson Summary

Key points to remember:

A. The structure of a soil directly affects the management and usage of that soil. Common soil structures include single grain, granular, crumb, blocky, prismatic, columnar, platy, and massive. Granular and crumb structures are best for cultivation purposes.

B. Every soil profile consists originally of a topsoil layer, a subsoil layer, and a parent material layer. The topsoil and subsoil directly affect management and usage.

C. Internal drainage ability of a soil is affected by texture, structure, hardpans, and organic material.

D. Surface drainage is chiefly affected by the slope of the soil surface.

LESSON 20

Classification Of Soils And Land

I. **Introduction:**

For many years, people have developed methods for classifying soil and land into groups which can be used to describe it. In the past, people often classified land on the basis of its selling price. Many years ago; land was described as being $40 an acre of land, $60 per acre of land, or $100 per acre of land. Other people referred to good cotton land or good pasture land.

In an effort to establish a nationwide system for soil classification, the Soil Conservation Service established a system for classifying soil according to its capability. This system is composed of a set of standards by which all land and soil in the United States can be placed into one of eight classes.

This lesson is designed to develop the student's knowledge of the soil capability classes and the ability to classify soils into these classes.

II. **Objectives:**

A. **Terminal objective.** Upon completion of this lesson, the student should be able to describe the eight different soil capability classes and to place a given soil in one of these classes.

B. **Specific objectives.** Upon completion of the lesson, the student should be able to do the following:

1. Define new terms related to soil classification.
2. Name the factors to be considered in classifying soils.
3. Describe the four degrees of water erosion.
4. Describe the four degrees of soil depth.
5. Describe the four degrees of surface drainage.
6. Describe the four major uses of agricultural land.
7. Describe the characteristics and uses of the eight soil capability classes.
8. Classify a given soil and recommend its highest use.

III. **Instructional Procedures:**

Teaching Tasks	Steps to Accomplish Tasks
A. Prepare for class.	1. Review entire lesson and determine if additional material is needed. 2. Prepare transparencies and student handouts.
B. Introduce the lesson.	1. Discuss reasons for classifying soils. 2. Discuss terms and definitions found in Section A of Learning Activities.
C. Identify the factors used in classifying soil as to capability.	1. Discuss the five factors found in section B of Learning Activities. 2. Review briefly factors such as slope and internal drainage which were discussed in previous lessons.

92

Teaching Tasks	Steps to Accomplish Tasks
D. Determine extent of erosion.	1. Discuss the two types of water erosion. 2. Define the four degrees of erosion as found in Section C of Learning Activities. 3. Demonstrate how depth of original topsoil is determined. 4. Provide several sample problems for students to determine extent of erosion.
E. Determine depth of a soil.	1. Discuss how the depth of a soil is determined. 2. Define the four categories of soil depth.
F. Determine surface drainage.	1. Discuss how surface drainage is determined. Stress that the amount of water which runs off is an important factor. 2. Define the four categories of surface drainage.

Teaching Tasks	Steps to Accomplish Tasks
G. Identify the different types of soil uses.	1. Discuss the four different uses of soils. 2. Stress that soils adaptable to rowcrop usage can also be used for pasture, woodland, and wildlife.
H. Identify characteristics and uses of the eight classes of soil capability.	1. For each of the eight classes of soil, identify the characteristics including slope, extent of erosion, soil depth, internal drainage, and surface drainage. Refer to the Jobs. 2. For each class of soil, discuss the highest safe use of that soil type and any treatments which could be needed.
I. Classify a soil as to its capability class and highest safe usage.	1. Provide all students with three copies of Student Assignment sheet. 2. In an area located near the school, demonstrate again how texture, internal drainage, depth, slope, erosion, and surface drainage are determined.

Teaching Tasks	Steps to Accomplish Tasks
	3. Explain to students how these factors are analyzed to determine soil class. Determine and mark soil class. 4. Determine highest safe use and explain to students. 5. On two different sites allow students to perform their own analyses of soil capability.
J. Summarize the lesson.	1. Discuss key points to remember as found in Lesson Summary.

IV. Learning Activities:

A. New terms and definitions

1. *Land capability classification*—A grouping of soils into special classes based upon their capability for intensive usage and the treatments required for such usage.
2. *Highest safe use*—A term used to refer to the most productive and profitable use for which a soil can be used without endangering that soil.
3. *Erosion*—The wearing away of the land surface by the action of water, wind, or other agents.

B. What factors are considered in classifying soils according to use?

The Soil Conservation Service, an agency of the U. S. Department of Agriculture, uses the following factors in establishing the capability class of a soil:

1. Slope.
2. Extent of erosion.
3. Soil depth.
4. Internal drainage (permeability).
5. Surface drainage.

C. How is the degree or extent of erosion determined?

Here in Mississippi, land owners should be most concerned by water erosion. This erosion can be caused by raindrop splash, the flowing effect of small streams of water, or a combination of these factors. Raindrop splash causes sheet erosion which is characterized by a gradual movement of the entire soil surface down the slope. Small streams of water moving down a slope can cause gully erosion in which large ditches are washed into the soil.

The terms listed below are used to describe the extent of erosion of a given soil:

1. *None to slight:* Less than 25 percent of surface soil lost. No gullies.
2. *Moderate:* 25 to 75 percent of surface soil lost. May have a few small gullies.
3. *Severe:* More than 75 percent of surface soil lost, with no uncrossable gullies present.
4. *Very severe:* More than 75 percent of surface soil lost,with uncrossable gullies and eroded ditches.

To determine the extent of surface soil lost, you must measure the depth of the soil surface layer in an area which has not been cultivated or disturbed. This area must have the same slope and texture of soil as found in the area to be classified. If depth of the topsoil in this area is six inches and the topsoil is three inches thick in the area to be classified, then 50 percent of the topsoil has been lost. The soil would be said to be moderately eroded. If all topsoil has been removed, then the soil is severely eroded.

Uncrossable gullies refer to gullies which cannot be safely crossed with a tractor.

D. How is the depth of the soil determined?

For agricultural purposes, the depth of a soil is determined by the total thickness of the topsoil and subsoil that can be readily penetrated by plant roots. The depth of a soil is measured from the soil surface to the parent material, or hardpan if present. Hardpans caused by traffic are not considered to limit the soil depth.

Definitions of soil depth are listed below:

1. *Deep.* Soils having a root growth zone of 30 inches or more.
2. *Moderately deep.* Soils having a root growth zone of 20 to 30 inches.
3. *Shallow.* Soils having a root growth zone of 10 to 20 inches.
4. *Very shallow.* Soils having a root growth zone of less than 10 inches.

E. How is surface drainage determined?

As mentioned in the previous lesson, surface drainage is most strongly affected by the surface slope. In determining surface drainage for soil classification purposes, the relative amount of water removed that is in excess of the amount that can be absorbed by the soil is considered. This means a nearly level, shallow soil with slow internal drainage may have excessive surface drainage even if the slope is less than 8 percent.

The different classes of surface drainage are defined below:

1. *Good.* There are no water drainage problems.
2. *Fair.* Water is removed slowly. Surplus surface water is a problem at times.
3. *Poor.* Water is removed so slowly from the surface that the soil remains wet for long periods of time.
4. *Excessive.* Water is removed so rapidly that erosion can occur and insufficient amounts penetrate into the soil.

   Any soil having a slope greater than 8 percent will have excessive surface drainage. Soils which have a 2 to 8 percent slope may have good to excessive surface drainage depending upon texture and other factors. Soils having a 0 to 2 percent slope can have good, fair or poor drainage depending upon the area and the soil.

F. What are the different types of usage of soils?

In general there are four different uses for agricultural lands. These uses are the following:

1. *Cropland.* This is the highest productive use of land from an economic viewpoint. Rowcrops offer the greatest return to a farmer's investment. Unfortunately, not all soils are suitable for rowcropping.
2. *Pastureland.* This use is the second highest usage for soil. Problems of erosion, drainage, slope, or soil properties may make the growing of rowcrops impractical. Permanent pasture, however, may still be practical.
3. *Woodland.* In many cases, land and its soil may not be suitable for even pasture production. Forestry or woodland usage is the next alternative.
4. *Wildlife and recreation.* This is the lowest order of land usage. It is assigned to areas which cannot even produce forest products safely or economically.

G. What are the characteristics and uses of the eight land capability classes? (See TM 20a.)

Class I land is the most productive class of land. It is nearly level and has no to only slight erosion. Class I land has a deep soil with moderate internal drainage and good surface runoff. This type of land is very productive and can be cultivated for rowcrops without any special treatment.

Class II land may have one of two different types of soil. The first type is gently sloping with deep or moderately deep soils. This soil may be slightly or moderately eroded, has moderate internal drainage, and has good surface drainage.

The second type of soil which falls into the Class II grouping is nearly level with slight to moderate erosion. It is deep-to-moderately deep and has slow internal drainage and good or fair surface drainage. Drainage ability of these soils prevents them from being Class I lands.

Class II soils are suitable for rowcropping but require moderate treatment such as terracing, contour cultivation, or possibly drainage ditches in low spots. Under proper management many Class II soils are as productive as Class I soils.

Class III soils may also be one of two different types. The first type is a deep-to-moderately deep soil with a moderate slope. Erosion is slight to moderate; internal drainage is slow to rapid; and surface drainage may be good to excessive. The second type is also a deep-to-moderately deep soil with a nearly level-to-gently sloping slope. Erosion on this type of soil may be slight to moderate and surface drainage, good to excessive. Internal drainage is rapid.

Class III land can safely be used for rowcrops if extensive management practices are followed. Such practices include using soil conservation, improving crops every second year, and managing crop residue to prevent erosion. Terracing and contour farming are musts for Class III lands with moderate slopes. Drainage systems are needed for low-lying areas with slow internal drainage.

Class IV land may have one of two types of soil. The first type has a strongly sloping slope with slight-to-severe erosion. The soil is deep or moderately deep, has moderate-to-slow internal drainage, and excessive surface drainage. The second type is nearly level with slight erosion. It is shallow in depth, has slow-to-very slow internal drainage, and fair surface drainage.

Class IV land is primarily suitable for pasture usage. This class requires constant use of close-growing sod crops or heavy-duty vegetation. Proper management and control of grazing are important.

Class V land is nearly level with only slight, if any, erosion. The soil on this class of land is very shallow, however, with very slow internal drainage and only fair surface drainage. If the area can be economically drained, the highest safe use would be pasture. If not, the land should be used for woodland purposes. There is very little Class V land in Mississippi.

Class VI land may have one of two soil types. The first type has a steep surface with slight-to-moderate erosion. The soil is deep-to-shallow in depth, has rapid to very slow internal drainage and excessive surface drainage. The second type has a strongly sloping surface and excessive erosion. Depth, internal drainage, and surface drainage are the same as the first type. Class VI soils may be used for permanent pasture if the terrain can be safely crossed with equipment. If not, then the soil should be used for woodland purposes.

Class VII land is very steep. Erosion may be slight to severe. Soil depth is deep to very shallow. Internal drainage may be rapid to very poor. Surface drainage is always excessive. This class of land will always be used for woodland purposes.

Class VIII land is extremely steep. Generally speaking, this land is unsuited for agricultural purposes. Examples of such land include rock outcroppings, sandy beaches, permanent swamps, and tidal marshes. There is very little Class VIII land in Mississippi. Such land, where it does exist, is suitable for wildlife and recreation purposes only.

G. What are the characteristics and uses of the eight land capability classes? (See TM 20a.)

Class I land is the most productive class of land. It is nearly level and has no to only slight erosion. Class I land has a deep soil with moderate internal drainage and good surface runoff. This type of land is very productive and can be cultivated for rowcrops without any special treatment.

Class II land may have one of two different types of soil. The first type is gently sloping with deep or moderately deep soils. This soil may be slightly or moderately eroded, has moderate internal drainage, and has good surface drainage.

The second type of soil which falls into the Class II grouping is nearly level with slight to moderate erosion. It is deep-to-moderately deep and has slow internal drainage and good or fair surface drainage. Drainage ability of these soils prevents them from being Class I lands.

Class II soils are suitable for rowcropping but require moderate treatment such as terracing, contour cultivation, or possibly drainage ditches in low spots. Under proper management many Class II soils are as productive as Class I soils.

Class III soils may also be one of two different types. The first type is a deep-to-moderately deep soil with a moderate slope. Erosion is slight to moderate; internal drainage is slow to rapid; and surface drainage may be good to excessive. The second type is also a deep-to-moderately deep soil with a nearly level-to-gently sloping slope. Erosion on this type of soil may be slight to moderate and surface drainage, good to excessive. Internal drainage is rapid.

Class III land can safely be used for rowcrops if extensive management practices are followed. Such practices include using soil conservation, improving crops every second year, and managing crop residue to prevent erosion. Terracing and contour farming are musts for Class III lands with moderate slopes. Drainage systems are needed for low-lying areas with slow internal drainage.

Class IV land may have one of two types of soil. The first type has a strongly sloping slope with slight-to-severe erosion. The soil is deep or moderately deep, has moderate-to-slow internal drainage, and excessive surface drainage. The second type is nearly level with slight erosion. It is shallow in depth, has slow-to-very slow internal drainage, and fair surface drainage.

Class IV land is primarily suitable for pasture usage. This class requires constant use of close-growing sod crops or heavy-duty vegetation. Proper management and control of grazing are important.

Class V land is nearly level with only slight, if any, erosion. The soil on this class of land is very shallow, however, with very slow internal drainage and only fair surface drainage. If the area can be economically drained, the highest safe use would be pasture. If not, the land should be used for woodland purposes. There is very little Class V land in Mississippi.

Class VI land may have one of two soil types. The first type has a steep surface with slight-to-moderate erosion. The soil is deep-to-shallow in depth, has rapid to very slow internal drainage and excessive surface drainage. The second type has a strongly sloping surface and excessive erosion. Depth, internal drainage, and surface drainage are the same as the first type. Class VI soils may be used for permanent pasture if the terrain can be safely crossed with equipment. If not, then the soil should be used for woodland purposes.

Class VII land is very steep. Erosion may be slight to severe. Soil depth is deep to very shallow. Internal drainage may be rapid to very poor. Surface drainage is always excessive. This class of land will always be used for woodland purposes.

Class VIII land is extremely steep. Generally speaking, this land is unsuited for agricultural purposes. Examples of such land include rock outcroppings, sandy beaches, permanent swamps, and tidal marshes. There is very little Class VIII land in Mississippi. Such land, where it does exist, is suitable for wildlife and recreation purposes only.

102

Land Capability Classification

CLASS	SLOPE	EROSION	DEPTH	INTERNAL DRAINAGE	SURFACE DRAINAGE	HIGHEST SAFE USE
I	Nearly Level	None to Slight	Deep	Moderate	Good	Rowcrop-Use Only Normal Treatment
II	Gently Sloping	Slight to Moderate	Deep or Moderately Deep	Moderate	Good	Rowcrop-Use Moderate Treatment
	Nearly Level	Slight to Moderate	Deep or Moderately Deep	Slow	Good or Fair	
III	Moderate	Slight to Moderate	Deep or Moderately Deep	Slow to Rapid	Good to Excessive	Rowcrop-Use Extensive Treatment
	Nearly Level to Gently Sloping	Slight to Moderate	Deep or Moderately Deep	Rapid	Good to Excessive	
IV	Strongly Sloping	Slight to Severe	Deep or Moderately Deep	Moderate to Slow	Excessive	Pastureland With Moderate Treatment
	Nearly Level	Slight	Shallow	Slow to Very Slow	Fair	
V	Nearly Level	None to Slight	Very Shallow	Very Slow	Fair	Pasture With Extensive Treatment or Woodland
VI	Steep	Slight to Moderate	Deep to Shallow	Rapid to Very Slow	Excessive	Pasture With Extensive Treatment or Woodland
	Strongly Sloping	Excessive	Deep to Shallow	Rapid to Very Slow	Excessive	
VII	Very Steep	Slight to Very Severe	Deep to Very Shallow	Rapid to Very Slow	Excessive	Woodland
VIII	Very Steep	Slight to Very Severe	Deep to Very Shallow	Rapid to Very Slow	Excessive	Wildlife and Recreation

V. **Supplementary Activities:**

A. Make a slide set of different classes of soil in the local community.

B. Have students survey the soil on a local field or their home farm and prepare a report.

C. If available, secure a copy or copies of the Soil Survey Report for your county. Teachers may want to prepare a lesson by itself concerning using this valuable document.

VI. **Supplementary Learning Aids:**

A. Transparency Masters:

1. TM 20a, Land Capability Classification

B. References

Agribusiness Education Service. **Soils: Land Capability Classes**. Montgomery, AL: Alabama State Department of Education, 1976.

Carter, L. S. and Leighty, R. V. **Soils Manual for Land Judging.** San Luis Obispo, CA: Vocational Education Productions, n.d.

Jacks, L. P. and Hamilton, J. R. **Basic Principles of Soil Science.** Mississippi State: Research and Curriculum Unit, Reprinted 1978.

Palmertree, Hiram D. et.al. **Instructions on Land Judging in Mississippi.** Bul. No. 679, Mississippi State: Mississippi Cooperative Extension Service, 1976.

South Carolina State Department of Education. **Soil Classification and Treatment.** Columbia, SC, 1976.

ASSIGNMENT SHEET 20a

Provide each student with three copies of the following worksheet. In an area located adjacent to the school demonstrate again how to determine texture, internal drainage, soil depth, erosion, and surface drainage. Use one copy of the worksheets to demonstrate how capability classes are determined. Have students do their own analysis of soil capability on two different sites.

ASSIGNMENT SHEET 20a

Student Worksheet: *Soil Classification*

Student's Name: _____

Place a check in the appropriate space.

A. Surface texture
- _____ Medium
- _____ Fine
- _____ Coarse

B. Internal Drainage
- _____ Moderate
- _____ Slow
- _____ Very slow
- _____ Rapid

C. Depth, Surface, and Subsoil
- _____ Deep
- _____ Moderately deep
- _____ Shallow
- _____ Very shallow

D. Slope
- _____ Nearly level
- _____ Gently sloping
- _____ Moderately sloping
- _____ Strongly sloping
- _____ Steep
- _____ Very steep

E. Erosion
- _____ None to slight
- _____ Moderate
- _____ Severe
- _____ Very severe

F. Surface Drainage
- _____ Good
- _____ Fair
- _____ Poor
- _____ Excessive

G. Classification
- _____ Class I
- _____ Class II
- _____ Class III
- _____ Class IV
- _____ Class V
- _____ Class VI
- _____ Class VII
- _____ Class VIII

H. Highest Safe Use
- _____ Cropland
- _____ Pasture
- _____ Woodland
- _____ Wildlife and Recreation

VII. **Lesson Summary:**

Key points to remember:

A. The classes of soil use are based upon the determination of a soil's ability to produce on an economical and safe basis.

B. In Mississippi, land owners should be concerned primarily with water erosion rather than wind erosion.

C. A soil's highest safe use is determined by studying its slope, extent of erosion, depth, and surface and internal drainage.